Library of the Marine Corps
3000205301

MARINE CORPS UNIVERSITY LIBRARY

AD530310

COPY AVAILABLE TO DDC DOES NOT PERMIT FULLY LEGIBLE PRODUCTION

AV-8A

CONCEPT OF OPERATIONS STUDY

FINAL REPORT TASKS 1, 2, & 3

PROJECT NO. 54-68-01

AUGUST 1973

DDC
RECEIVED
JUN 27
FI



DOWNGRADED BY ...
DOD D 5200.10 ...
AUTOMATICALLY DOWNGRADED AT TWO YEAR INTERVALS
DECLASSIFIED ON ...

DEVELOPMENT CENTER

MARINE CORPS DEVELOPMENT AND EDUCATION COMMAND

QUANTICO, VIRGINIA

DIRECTOR MARINE CORPS RESEARCH CENTER
ATTN COLLECTION MANAGEMENT (C40RCL)
MCCDC
2040 BROADWAY ST
QUANTICO VA 22134-5107

UG
1242
.V47
G85
1973a
QMCA





DEPARTMENT OF THE NAVY
HEADQUARTERS UNITED STATES MARINE CORPS
WASHINGTON, D.C. 20380

[redacted]

IN REPLY REFER TO
RD/AAP-51-mrc
6 MAY 1974

[redacted] (Unclassified upon removal of enclosure (1) to the basic document)

From: Commandant of the Marine Corps
To: Distribution List

Subj: AV-8A Concept of Operations Study

1. The objectives of this study were to:

a. Develop a concept for employment of AV-8A aircraft aboard suitable Navy Sea Bases.

b. Develop a concept for shore based employment of the AV-8A.

c. Determine changes required to the Marine Command and Control System in order to employ effectively the AV-8A.

2. The objectives of the study have been achieved. It should be noted that this study is not exhaustive in its analysis but is rather a preliminary analysis in the continuing development of AV-8A operational concepts.

3. The results of the study are concurred in subject to the understanding that the methods of employment of the AV-8A described herein are feasible methods only. These concepts of operation for the AV-8A should not be interpreted as Marine Corps Doctrine.

4. The assumptions used in this study should be reviewed carefully before the conclusions are applied to actual AV-8A operations. The conclusions are extremely sensitive to the following assumptions which were used in the evaluation of sea based operations:

a. Only CH-46 type helicopters were considered.

b. Attrition was not included in the analysis.

c. Potential for delays and bottlenecks was not analyzed.

DDC
JUL 23 1974

[redacted]

CONFIDENTIAL (Unclassified upon removal of enclosure (1) to the basic document)

Subj: AV-8A Concept of Operations Study

d. Potential for interruptions during the landing of initial assault elements was not included in the analysis.

5. The conclusions contained herein must therefore be validated by actual operations before they can be considered suitable for planning and programming purposes.

6. A copy of this letter will be affixed inside the front cover of each copy of the subject study prior to its distribution.

F. C. [illegible]
Chief of Staff

DISTRIBUTION:
DDC (20)
CMC (RD) (10)
CMC (AA) (10)
CMC (P)
CMC (I&L)
CG, FMFLANT (5)
CG, FMFPAC (5)
CG, I MAF (2)
CG, III MAF (2)
CG, 1st MARDIV (2)
CG, 2d MARDIV (2)
CG, 3d MARDIV (2)
CG, 4th MARDIV (2)
CG, 1st MAW (5)
CG, 2d MAW (5)
CG, 3d MAW (5)
CG, 4th MAW (5)
Dir, Education Center
CG, 3d MAB
CG, FORTRPS, FMFLANT
CG, FORTRPS, FMFPAC
CG, 1st MAR Brigade
CO, LFTCLANT
CO, LFTCPAC
CO, TBS, MCDEC
CO, MCAS, Quantico
OIC, MCTSSA, MCB, Camp Pendleton, Calif. 92055

[redacted]

RD/AAP-51-MM[illegible]

[redacted] (Unclassified upon removal of enclosure (1) to the basic document)

Subj: AV-8A Concept of Operations Study

DISTRIBUTION: (Cont'd)
CO, MAG-14 (2)
CO, MAG-32 (2)
CO, VMA-231 (2)
CO, VMA-513 (2)
CO, VMA-542 (2)
MCLnO, COMPHIBLANT
MCLnO, USACDC, Ft. Belvoir, Va. 22060 (2)
MCLnO, USAAVN Test Bd, Ft. Rucker, Ala. 36360
Chief, MC Section, USACGSC, Ft. Leavenworth, Kan. 66027
MCLnO, NWL, Dahlgren, Va. 22448
CNO (OP-03)
CNO (OP-05)
CNO (OP-34) (2)
CNO (OP-36)
CNO (OP-508)
CNO (OP-512)
CNO (OP-722)
CNO (OP-506C5)
CNA
CHNAVMAT
NAVAIRSYSCOM (5)
NAVORDSYSCOM

[redacted]

UNCLASSIFIED

Opinions, conclusions, and recommendations contained in this report are those of the Development Center, Marine Corps Development and Education Command and are not to be construed as reflecting the view or endorsement of the Commandant of the Marine Corps.

Reference may be made to this report by government agencies in the same way as to published articles, that is, noting title, source, date, and project number.

DDC
(Code AX)

2 JUN 74

EACH TRANSMITTAL OF THIS DOCUMENT OUTSIDE THE AGENCIES OF THE U.S. GOVERNMENT MUST HAVE PRIOR APPROVAL OF THE COMMANDANT OF THE MARINE CORPS (CODE AX).

WARNING

This material contains information affecting the national defense of the United States within the meaning of Espionage Laws, Title 28, U. S. C., Section 793 and 794. Its transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law.

"NATIONAL SECURITY INFORMATION"

"Unauthorized Disclosure Subject to Criminal Sanctions"

UNCLASSIFIED

UNCLASSIFIED

If the amphibious operation progresses to basing ashore, a Main Base will be established during Phase Three to provide full support ashore. The Main Base can be expanded to serve as an expeditionary airfield for other fixed-wing aircraft if these also are to be brought ashore. Facilities and Forward Sites will continue to be established and relocated as desired to support the scheme of maneuver. The desirability and use of Forward Sites is expected to be limited by the requirements for security and logistic support and by the limitations they may impose on the mobility of forward ground units. To minimize cost and complexity of logistic support, AV-8A's will routinely operate out of the largest and most complete base that meets the response requirements of the ground forces.

This concept of operation is compatible with the Marine Air Command and Control System. When minimum response time is paramount, the Direct Air Support Center may assign forward based AV-8A's to be launched in direct response to mission requests from designated ground units.

This concept of operation allows the AV-8A to provide responsive air support for the ground forces in all phases of an amphibious operation, to stage ashore early without extensive base development, and to improve the responsiveness of close air support.

PRECEDING PAGE BLANK-NOT FILMED

UNCLASSIFIED

UNCLASSIFIED

(U) TABLE OF CONTENTS

Subject	Page
Frontispiece	i
Abstract	ii
Table of Contents	iv
Basic Report	
Section 1. Introduction	1
Section 2. Concept for Sea Based Operation	4
Section 3. Concept for Land Based Operation	10
Section 4. Related Studies	15
Annex A - Mission Requirements	
Section 1. Introduction	A-1
Section 2. Mission Characteristics	A-2
Annex B - Aircraft Characteristics	
Section 1. Aircraft Description	B-1
Section 2. AV-8A Performance	B-6
Section 3. Maintenance and Reliability	B-18
Annex C - Ship Compatibility	
Section 1. Introduction	C-1
Section 2. Ships Suitable as Sea Platforms or Sea Bases	C-3
Section 3. Sea Base Characteristics	C-12
Section 4. Sea Platform Characteristics	C-39
Section 5. Sea Base Operations	C-56
Section 6. Summary	C-93
Annex D - AV-8A Basing	
Section 1. Basing Requirements	D-1
Section 2. Major Support Equipment and Layout	D-18
Section 3. Preparation and Installation	D-22
Section 4. Security	D-37
Annex E - Command and Control	
Section 1. Introduction	E-1
Section 2. Command and Control Systems	E-2

UNCLASSIFIED

UNCLASSIFIED

(U) TABLE OF CONTENTS (Continued)

Subject		Page
Section 3.	Command Control During Employment of the AV-8A	E-5
Annex F - Logistic Support		
Section 1.	Logistic Requirements	F-1
Section 2.	Maintenance Concept	F-10
Section 3.	Vehicle Requirements	F-16
Section 4.	Helicopter Requirements	F-19
Section 5.	Shipboard Support	F-23
Section 6.	Support Ashore	F-25
Annex G - Weapons Effectiveness		
Section 1.	Introduction	G-1
Section 2.	Missions	G-3
Section 3.	Target Descriptions and Vulnerability	G-7
Section 4.	Weapon Candidates for the AV-8A	G-17
Section 5.	Ordnance Capacity and Delivery Accuracy of the AV-8A	G-24
Section 6.	Weapon Effectiveness	G-27
Section 7.	Weapon Selection	G-56
Section 8.	Support Equipment Required to Maintain the Armament Equipment of the AV-8A	G-85
Section 9.	AV-8A Air-to-Air Capability	G-90
Section 10.	Conclusions	G-95
Annex H - Distribution		
Distribution List		H-1

UNCLASSIFIED

[redacted]

UNITED STATES MARINE CORPS
Marine Corps Development and Education Command
Quantico, Virginia 22134

Project No.: 54-69-01 (Tasks 1, 2, and 3)

Subject: AV-8A Concept of Operation Study, Final Report (U)

References:
(a) CG, MCDEC ltr 46/3B/RFJ:mbt of 22 Jul 1970, Subj: AV-8A Concept of Operations STudy Outline
(b) CG, MCDEC ltr 46/3B/HLM:rjs of 15 Oct 1970, Subj: Operational Concept for Employment of AV-8A
(c) CMC Confidential ltr AAW-1B-spl over 13110, Ser: C060078 of 21 Jul 1970, Subj: Operational Concept for Employment of AV-8A (U)
(d) CMC ltr AAW-1A-gd over 3900 of 24 Aug 1970, Subj: AV-8A Concept of Operations
(e) CNO/CMC joint ltr OP-05 over 13110/AAW-1B-spl over 13110 of 27 Aug 1970, Subj: Planning and Prosecution of Project BATTLE CRY

SECTION 1. INTRODUCTION (U)

101. (U) Purpose. The purpose of this study, as specified in references (a) and (b), is to achieve the objectives established for task 1, 2, and 3 of reference (c):

a. Develop a concept for employment of AV-8A aircraft aboard suitable Navy Sea Bases.

b. Develop a concept for shore based employment of the AV-8A.

c. Determine changes required to the Marine Air Command and Control System in order to employ effectively the AV-8A.

102. (U) Assumptions

a. The following assumptions made in this study were specified in references (a) and (d):

(1) The inventory of U.S. Navy amphibious shipping will adhere to the projections of NPO 72, and the constraint of this force level must be considered in concept validation.

(2) AV-8A performance will be as stated in CMC requirement for V/STOL Close Air Support Aircraft contained

WARNING
This material contains information affecting the National Defense of the United States within the meaning of espionage laws, title 18, U. S. C. sections 793 and 794. Its transmission or revelation of its contents in any manner to an unauthorized
CLASSIFIED BY CMC (DX)
SUBJECT TO GENERAL DECLASSIFICATION SCHEDULE OF EXECUTIVE ORDER 11652
AUTOMATICALLY DOWNGRADED AT TWO-YEAR INTERVALS
DECLASSIFIED ON 31 DECEMBER [redacted]

[redacted]

[redacted]

in CMC Confidential msg 231956Z Dec68 and CMC Confidential msg 312327Z Dec68.

(3) Marine Corps aviation assets, including the AV-8A, will be according to planned objectives. Projections for the 1975-1980 time frame will be used in this study.

(4) When peculiar AV-8A aircraft operational/maintenance data are not available, corresponding A-4 aircraft data will be considered representative for concept purposes.

(5) Dual carriage of stores will be available on all wing stations.

(6) The Marine Air Command and Control System will be sufficiently flexible to exploit the unique capabilities of the AV-8A.

b. The following major assumptions were made during the development of this study:

(1) Performance of the AV-8A with the Pegasus 11 engine will be as presented in Annex B.

(2) Criteria for shipboard operation of the AV-8A will be as discussed in Annex C.

(3) Weapons effects will be as discussed in Annex G.

103. (U) Facts. The following major factual data have a bearing on this study:

a. Physical characteristics of the AV-8A are as described in Annex B.

b. Physical characteristics of Navy ships are as described in Annex C.

104. (U) Discussion. Because of its unique vertical and short take-off and landing (V/STOL) characteristics, the AV-8A represents more than the introduction of a new aircraft model into the Marine Corps inventory. Optimum employment of the AV-8A necessitates a concept of operation which exploits the features of V/STOL to meet Marine Corps mission requirements. At the same time, the concept of operation must be compatible with the employment of other aircraft and with current and projected equipment and doctrine. The concept of operation which follows in Sections 2 and 3 was developed

WARNING

This material contains information affecting the National Defense of the United States within the meaning of espionage laws, title 18, U. S. C. sections 793 and 794. Its transmission or the revelation of its contents in

CLASSIFIED BY [redacted]
SUBJ TO GENERAL DECLASSIFICATION SCHEDULE OF EXECUTIVE ORDER 11652
AUTOMATICALLY DOWNGRADED AT TWO YEAR INTERVALS
DECLASSIFIED ON 31 DECEMBER 1979

[redacted]





with these objectives in mind, considering the following major factors:

a. Mission requirements, developed in Annex A. The requirements for AV-8A support were derived from general considerations for a Marine Amphibious Unit (MAU), Marine Amphibious Brigade (MAB), and Marine Amphibious Force (MAF).

b. Aircraft characteristics, described in Annex B. Characteristics of interest are physical description, mission performance, and maintenance and reliability.

c. Ship compatibility, discussed in Annex C. This annex establishes capabilities of various ships to support AV-8A operations.

d. AV-8A basing, discussed in Annex D. Types of bases afloat and ashore are described, and a basing concept is developed for the spectrum of possible bases.

e. Command and control procedures, developed in Annex E. AV-8A operations are considered in the context of the Marine Air Command and Control System.

f. Logistic support, discussed in Annex F. Requirements for logistic support of the AV-8A basing concept are developed.

g. Weapons effectiveness, discussed in Annex G. Weapons effectiveness and selection are developed for the AV-8A.

105. (U) Conclusions

a. AV-8A can be operated from LPH and LHA amphibious ships, at some reduction in space normally available for helicopters and for landing force supplies, as well as from CVA and CVS aircraft carriers. (Annex C)

b. Other nonaviation ships may be used for dispersal at sea. (Annex C)

c. Flexibility during employment of the AV-8A ashore can be achieved by providing the capability to establish Forward Sites for austere forward basing, Facilities for limited logistic support, and a Main Base for complete logistic support ashore, depending on the landing force mission and the tactical situation. (Annex D)

SECTION 2. CONCEPT FOR SEA BASED OPERATION (U)

201. (U) General. This section describes the concept for sea based operation of the AV-8A. Annexes A through G provide detailed information and rationale for the concept described below.

202. (U) Ship Characteristics. Navy ships capable of accommodating AV-8A operations are identified in Annex C. Two categories are considered: Sea Bases, which are ships capable of fully supporting AV-8A operations for an extended period of time; and Sea Platforms, which are all other ships on which an AV-8A can land and take-off. Potential Sea Bases comprise the CVA, CVS, LPH, and LHA classes of ships. Potential Sea Platforms include the LPD, LSD, LCC, AE, AOE, and ACR ship classes.

203. (U) Sea Based Employment. AV-8A's will operate from Sea Bases and Sea Platforms prior to phasing ashore or, when necessitated by political or tactical considerations, for the entire duration of an amphibious operation. While the primary mission of the AV-8A will be close air support, it may perform deep air support, armed reconnaissance, helicopter escort, air defense, emergency resupply, search and rescue, visual and photo reconnaissance, and psychological warfare missions. Mission requirements developed in Annex A are summarized below:

a. Marine Amphibious Unit Operations. In the event that a CVA or CVS is not available to support a Marine Amphibious Unit (MAU), and because an MAU generally requires significantly less air support than can be provided from a CVA or CVS, it is expected that AV-8A's and helicopters using an LPH or an LHA as a Sea Base can provide the air support required for an MAU. Since an MAU is normally supported from its Sea Base, AV-8A's supporting the MAU must be capable of operating from the Sea Base for the duration of the operation.

b. Marine Amphibious Brigade Operations. Depending on the need for and availability of a CVA or CVS to support a Marine Amphibious Brigade (MAB), AV-8A's may or may not be the sole fixed-wing aircraft from afloat supporting the MAB.

(1) When AV-8A's provide the sole support from afloat, mission requirements will generally necessitate a full squadron of 20 aircraft, operating from LPH and/or LHA Sea Bases. Logistic support would be centralized aboard one of the Sea Bases in the Amphibious Task Force. Sea Platforms would be used as desired and available. Since the MAB is envisioned as capable of operating from Sea Bases or from

[redacted]

ashore, AV-8A's supporting the MAB must be capable of both sea based and shore based operations.

(2) When augmenting other aircraft operating from a CVA or CVS, AV-8A's may be based on the CVA/CVS or on LPH or LHA Sea Bases, as described above. Since AV-8A's reduce the space available to helicopters aboard the LPH or LHA, the AV-8A's can be based on the CVA/CVS when a maximum helicopter capability is desired aboard the LPH's and/or LHA's. AV-8A operations aboard the CVA/CVS are similar to other fixed-wing aircraft operations, except that the catapults and arresting gear are not used, and when phasing ashore, the AV-8A can be deployed ashore before other fixed-wing aircraft.

c. Marine Amphibious Force Operations. A Marine Amphibious Force (MAF) will generally include one squadron of 20 AV-8A's. The AV-8A's could be based on a CVA or CVS when maximum helicopter capability is desired aboard the LPH's and/or LHA's. However, LPH or LHA Sea Bases may be used to support an MAF if desired, such as in support of independent operations, or when the LPH or LHA is in a more advantageous location than the CVA or CVS. AV-8A's supporting an MAF will be capable of rapidly phasing ashore to provide more responsive close air support for the ground forces.

d. Sea Bases selected for AV-8A operations must be selected for each particular operation considering:

(1) Air support requirements.

(2) Number of AV-8A's to be assigned.

(3) Other air support available.

(4) Ships available.

(5) Projected location of ships and ground forces during the operation.

(6) Helicopter capability required aboard LPH's and/or LHA's.

(7) Desired basing posture afloat and ashore.

204. (C) Basing Concept.

a. Sea Bases.

(1) CVA or CVS. Basing of AV-8A's aboard CVA or CVS ships will follow the practice for other aircraft. The

[redacted]

[redacted]

AV-8A's will generally launch from the catapult area using short take-off (STO) rather than catapult assist, and it will land in the recovery area using rolling vertical landing (RVL) rather than arresting wires. This procedure facilitates integration of AV-8A operation on the CVA or CVS and allows STO payload to be carried.

(2) LPH or LHA. The most significant effects of the AV-8A basing on the LPH or LHA are a reduction in deck space available to helicopters and a requirement to stow, assemble, and load aviation ordnance.

(a) Basing of AV-8A's aboard amphibious ships will thus necessarily reduce the maximum helicopter complement. For example, as shown in Annex C, basing six AV-8A's on an LPH will reduce the maximum helicopter complement from 27 CH-46 equivalents to 18 CH-46 equivalents.

(b) Ordnance storage and handling will require that appropriate space aboard the LHA be designated for ordnance handling if that ship is to serve as a Sea Base. AV-8A ordnance space aboard the LPH would require a reduction in ship space available for other embarked units, for landing force reserve material, or for other functions.

(c) When an entire squadron of AV-8A's is to be based aboard amphibious ships, it will generally be desirable to base all the aircraft aboard one LPH or LHA in order to minimize complexity of operations and duplication of support. During the ship-to-shore movement, AV-8A's could be dispersed to other ships if necessary to facilitate helicopter offloading of units embarked on the LPH or LHA serving as a Sea Base.

(d) When AV-8A's are operated together with helicopters aboard an LPH or LHA, on-call AV-8A's will operate from the aft spots in a VTOL mode. To maximize ordnance payload, preplanned missions can be launched with STO deck run by scheduling AV-8A take-offs between or after helicopter waves, with proper planning to provide clear space on the flight deck during the AV-8A launch. Variations of deck spotting is discussed in Annex C.

b. Sea Platforms. Sea Platforms may be used for VTOL operations when it is desired to disperse AV-8A's from Sea Bases, or when the Sea Platform provides a more advantageous position for launching or recovering an AV-8A mission. An on-call AV-8A can be positioned aboard a Sea Platform and maintained in condition for launch. Mission ready aircraft will normally be flown from a Sea Base to a Sea Platform and

[redacted]

refueled to VTO launch weight at the Sea Platform. When AV-8A mission is recovered at a Sea Platform, it may be refueled for the next mission or for transfer to the Sea Base. As discussed in Annex C, it is also possible to position ordnance, ordnance handling equipment, and personnel to rearm AV-8A's aboard an LPD Sea Platform. Generally, however, servicing at a Sea Platform will be limited to refueling and replenishment of demineralized water.

205. (U) Logistics and Support.

a. Maintenance.

(1) A Sea Base is capable of providing organizational maintenance (OMA) and intermediate maintenance (IMA) support. Maintenance personnel, equipment, and supplies must be brought aboard by the AV-8A unit. As discussed in Annex C, most AV-8A maintenance activities will be located in the shops aboard Sea Bases or in vans brought aboard for maintenance support. When shipboard operation is to take place for a limited time, it may be desirable to bring aboard enough line replaceable units (LRU's) to support shipboard operations rather than positioning IMA on the Sea Base. However, this practice would necessitate an adequate supply of LRU's and would limit the duration for which AV-8A's could operate from the Sea Base.

(2) Sea Platforms will not normally provide maintenance support. However, if the Sea Platform is to have the capability to turn around AV-8A's for subsequent missions, the following support must be positioned aboard a Sea Platform:

(a) Personnel and equipment for servicing.

(b) Capability to replenish demineralized water.

(c) Ordnance, loading equipment, and personnel.

b. Shipboard Support. A ship serving as a Sea Base will provide the billeting, mess, administrative, and other support normally provided for embarked aviation units. The most significant AV-8A support requirement is for aviation ordnance handling aboard LPH and LHA type ships, since these ships now support only helicopters. Ship space must be provided for aviation ordnance stowage and assembly. Also, the ship's company must be augmented to take on, assemble, and handle this type of ordnance aboard the LPH or LHA; and liquid oxygen must be stowed and periodically replenished. High purity liquid nitrogen is required if Sidewinder missiles are carried.

TABLE 2-1. (U) TYPICAL AV-8A SEA BASED CONSUMPTION FACTORS.

	SEA BASE	SEA BASE	SEA PLATFORM
No. of AV-8A's	6	20	1
Sorties Per Day	24	80	4
DAILY REPLENISHMENT			
Ordnance	38 S/T	125 S/T	.4 S/T
Fuel	26 S/T (7,600 gal)	88 S/T (25,800 gal)	6.8 S/T (2,000 gal)
Water*	2 S/T (480 gal)	6 S/T (1,440 gal)	3 S/T (75 gal)
Materials	1 S/T	3 S/T	-

* Demineralized water for jet engine use.

c. Resupply. For extended sea based operations, Sea Bases must be resupplied with aviation ordnance, fuel, and materials. AV-8A consumption factors are developed in Annex F; typical daily consumption factors for Sea Bases are summarized in Table 2-1. A minimum of 5-days replenishment interval is normally desired to avoid excessive frequency of resupply. Table 2-1 also summarizes consumption factors for a Sea Platform capable of turning around four AV-8A missions per day, assuming that only the guns are reloaded for each mission.

d. Helicopter Support. Since there is no routine requirement for helicopter support of sea based AV-8A's, it will generally be provided on an "as-required" basis, rather than by permanent assignment of helicopters. Helicopters will be required from time to time for ship-to-shore transfer of personnel and materials, to expedite delivery of high-priority spares and support equipment, and to bring maintenance teams and equipment to a Sea Platform in order to repair an unflyable AV-8A. When an unflyable AV-8A aboard a Sea Platform can not be repaired by a mobile maintenance team, it may be lifted to the Sea Base by a CH-53, or by the heavy lift helicopter projected for the mid-range time frame.

206. (U) Command and Control. Procedures for command and control of sea based AV-8A's, within the context of the Marine Air Command and Control System, are detailed in Annex E. Existing communication facilities aboard Sea Bases and

Sea Platforms appear adequate to meet the needs of AV-8A command and control. The Helicopter Direction Center (HDC) aboard LPH's and LHA's provides the means to alert and brief AV-8A missions, and the land/launch nets aboard Sea Bases and Sea Platforms will be used to control AV-8A launch and recovery.

207. (U) Mission Effectiveness. AV-8A mission payload capabilities for various mission profiles are described in Annex B, and effectiveness of various ordnance loads is discussed in Annex G.

SECTION 3. CONCEPT FOR LAND BASED OPERATION (U)

301. (U) General. This section describes the concept for land based operation of the AV-8A, including operations from a combination of sea and land bases and phasing ashore. Annexes A through G provide detailed information and rationale for this concept.

302. (U) Land Bases. The types of AV-8A bases are defined and described in Annex D. Three categories of land bases are considered:

a. A Main Base is a location ashore which can provide all facilities and support required for extended operation of AV-8A's, including maintenance, personnel, command and control, and all logistic support. The Main Base requires approximately 400 to 500 personnel, 779 tons of vehicles and equipment, and if a hard surface is not available, 218,000 square feet of matting. Typical daily resupply amounts to 161 tons of ordnance, 26,700 gallons of fuel, and 7 tons of materials for a squadron of 20 AV-8A's. A landing and take-off surface 1,500 feet long is desired. Engineer effort to establish a Main Base will vary with terrain and other conditions, as discussed in Section 3 of Annex D. For example, if a suitable surface is not available, a Main Base could be established on rough open terrain in 3 days using 23 pieces of engineer equipment and 87 men.

b. A Facility is a location ashore which can provide limited support for the AV-8A, including refueling, limited organizational maintenance, ordnance loading, limited personnel facilities, air operations support, and an area for landing and take-off. A Facility is therefore capable of turning around AV-8A's for subsequent missions. Backup logistic support must be provided from a Main Base or Sea Base. A Facility is expected to operate 6 to 10 aircraft. It requires approximately 78 to 116 men, 174 tons of vehicles and equipment, and if a hard surface is not available, 98,200 square feet of matting. Typical daily resupply for six AV-8A's amounts to 48 tons of ordnance, 7,950 gallons of fuel, and 1 ton of other materials. The landing and take-off surface is a strip at least 600 feet long. Engineer effort for a Facility is discussed in Section 3 of Annex D. As an example, if a suitable surface is not available, a Facility could be established on rough open terrain in 2 days using 21 pieces of engineer equipment and 76 men.

c. A Forward Site is a location ashore which is suitable for landing and take-off of an AV-8A. Mission ready aircraft can be staged to a Forward Site from a Main Base or Facility and remain on ground alert at the Forward Site.

The minimum requirement for a Forward Site is a 72 foot by 72 foot surface for vertical landing and take-off, amounting to 9 tons of AM6 matting if a suitable surface is not available. As an example, a Forward Site could be established in 1 day using 4 pieces of equipment and 19 men.

303. (U) Basing Concept. The three types of bases ashore represent discrete levels of AV-8A support capability. The Main Base provides full support, a Facility provides a capability for combat recycling, and a Forward Site accommodates mission ready aircraft at a forward location with no support. These bases may be used to establish a variety of basing postures, varying in degree of dispersal. These bases also represent steps in which a Forward Site can be used to establish operations ashore and incrementally expanded to a Facility and, if desired, a Main Base.

a. Main Base. A Main Base will be established only when full support is to be provided ashore. Because of the amount of materials involved, it is not likely to be displaced once established ashore, and it should be readily accessible to the source of supply. A Main Base also provides support for Facilities and Forward Sites if these are established. A base for other fixed-wing aircraft or helicopters can serve as an AV-8A Main Base, and will often do so when AV-8A's are operated with other aircraft, in order to utilize most effectively the assets of a Marine Aircraft Wing.

b. Facility. A Facility is more readily established and relocated, by helicopter transport if necessary. However, access by road is desirable to reduce the impact on helicopter lift available to the landing force. Logistic support must be provided from a Main Base or Sea Base. It is expected that AV-8A's will be deployed to a Facility for a period of up to several days and then returned to the Main Base or Sea Base for maintenance not accomplished at the Facility. The Main Base is also the source of ordnance, fuel, spares, and support equipment. A Facility may be established prior to establishing a Main Base ashore, or when AV-8A's are desired ashore, but the size or duration of the operation does not warrant establishing a Main Base, or to provide a forward location for improving responsiveness, or for dispersal.

c. Forward Site. A Forward Site can be more readily established at the optimum location for maximum responsiveness in support of ground units. However, it is envisioned that use of Forward Sites will be limited to those situations where dispersal or extreme forward basing is imperative, since use of a Forward Site imposes the following limitations:

(1) It may be difficult to provide security from enemy attack at an extreme forward location, and this may impose a burden on the ground units being supported.

(2) Ordnance loads may be limited to payloads for vertical landing and take-off operations.

(3) Communication augmentation may be required at the Forward Site.

(4) Each mission by an AV-8A from a Forward Site may entail an additional sortie for deployment from the Main Base, Facility, or Sea Base.

(5) If a need for maintenance arises at a Forward Site, it imposes a need to dispatch personnel and equipment from the Main Base or Facility, or for retrieval of the AV-8A by helicopter.

304. (U) Land Based Employment. AV-8A's may be phased ashore from Sea Bases and Sea Platforms, or they may be flown to the objective area. The primary mission of the AV-8A will be close air support; secondary missions include deep air suport, armed reconnaissance, helicopter escort, air defense, emergency resupply, search and rescue, visual and photo reconnaissance, and psychological warfare. The following concepts of employment are based on the mission requirements developed in Annex A:

a. Marine Amphibious Unit Operations. As discussed in Section 2 of this report, a Marine Amphibious Unit (MAU) will normally be supported from Sea Bases. However, it may be desirable in some tactical situations to establish one or two Forward Sites ashore to provide more responsive close air support. In cases where presence ashore is desired and feasible, a Facility may be established. It is not envisioned that a Main Base ashore would be established to support an MAU. Hence, AV-8A's in support of an MAU will operate either from a Sea Base and Sea Platforms, or from a combination of a Sea Base and Sea Platforms, or from a combination of a Sea Base and Forward Sites (or a Facility) ashore.

b. Marine Amphibious Brigade Operations. As discussed in Section 2 of this report, up to one squadron of 20 AV-8A's may be employed in support of a Marine Amphibious Brigade (MAB) in either a sea based or a land based posture, or with a combination of Sea Bases afloat and Facilities and Forward Sites ashore. Generally, no more than one Facility, one Main Base, and two Forward Sites would be utilized at any time. If AV'8A's are operated ashore together with other aircraft,

it will generally be most efficient to establish one base which serves as the AV-8A Main Base and supports the other fixed-wing aircraft and helicopters, since AV-8A V/STOL operations are compatible with both.

c. Marine Amphibious Force Operations. It is expected that a Marine Amphibious Force (MAF) will generally include one squadron of AV-8A's and that shore bases will be established in an MAF operation. Again, it will generally be more efficient to collocate the AV-8A Main Base with a shore base for other aircraft. The most dispersed posture would entail a Main Base, two Facilities, and four Forward Sites, but this is an extreme which is not often likely to occur. One Facility and two Forward Sites, in addition to the Main Base, are considered more likely. In an MAF operation, where AV-8A's will be only a fraction of the air support element, the AV-8A may supplement other fixed-wing aircraft or may be used as the principal source of close air support for selected ground units. The latter case, if applicable, will more effectively exploit V/STOL characteristics and forward basing by reducing response time through decentralized command and control, by reducing flying time to the target, and by even closer integration of the air and ground elements.

305. (U) Logistics and Support. Maintenance, transportation, stockage, and deployment are discussed in Annex F. The following major considerations apply in supporting AV-8A operations:

a. Engineer support must be provided for base construction. Division engineers will build the Forward Sites, whereas Force engineers or Mobile Construction Battalions would be utilized to expand the Forward Site or construct Facilities and Main Bases. Site selection criteria should be established for the operation.

b. The Headquarters and Maintenance Squadron and Marine Air Base Squadron of the Marine Aircraft Group must be provided with the necessary equipment, materials, and personnel to establish, operate, and support the AV-8A Main Base, Facilities, and Forward Sites once constructed.

c. Vehicle and helicopter support must be arranged. Resupply transportation requirements should be met on a routine basis.

d. Adequate stocks and resupply schedules must be established.

e. Embarkation and ship-to-shore movement must be planned.

TABLE 3-1. (U) AV-8A LOGISTIIC FACTORS

ITEM	MAIN BASE	FACILITY
No. of AV-8A's	20	6-10
Sorties Per Day	80	24-40
No. of Personnel	400-500	78-116
Ordnance, S/T Per Day	161	48-80
Fuel, Gallons Per Day	26,700	7,950-13,200
Materials, S/T Per Day	7	1
Equipment, S/T*	124	26
Vehicles and Towed Units	474	148
Matting, S/T**	239	102

* Shelters, support equipment, and materials.
** If appropriate surface is not available.

f. Logistic planning factors for a Main Base and Facility are summarized in Table 3-1.

306. (U) Command and Control. Procedures for command and control of the AV-8A during each phase of an amphibious operation are described in Annex E. These procedures are within the context of the Marine Air Command and Control System, and do not necessitate significant changes to that system. When minimum response time is paramount, the Direct Air Support Center may assign AV-8A's on ground alert at a Facility or Forward Site to be launched in direct response to mission requests from a designated ground unit.

307. (U) Mission Effectiveness. AV-8A payload capabilities are described in Annex B, and effectiveness of various ordnance loads is discussed in Annex G.

SECTION 4. RELATED STUDIES (U)

401. (U) Purpose. This section identifies the impact of AV-8A introduction on current and future studies. Because the AV-8A introduces a new type of aircraft and a new concept of operation, this impact is expected to be extensive. Three areas are addressed:

a. Impact on Baseline Studies in the functional areas of combat.

b. Recommended areas for additional study related to AV-8A's.

c. Implications for future Marine Corps requirements.

402. (U) Impact on Baseline Studies. A Baseline Study is defined as a study addressing one of the five functional areas of combat. Since each of these areas is affected by introduction of the AV-8A, it will have to be considered in planning and executing any Baseline Study. The impact is best established by addressing each functional area.

a. Mobility. The capability for forward basing of the AV-8A greatly enhances the mobility of landing force air support for purposes of responsiveness, dispersal, concealment, rapid change in posture, and phasing ashore. On the other hand, establishing and resupplying AV-8A bases absorbs some of the mobility assets (helicopters and vehicles) of the landing force. If Forward Sites are to be established, the necessity to establish and maintain security may also limit the mobility of the supported ground units. And when AV-8A's are based aboard amphibious ships, the number of helicopters which can operate from those ships is reduced. Quantitative mobility asset requirements are developed in Annex F, and impact of the AV-8A on ship based helicopter operations is discussed in Annex C.

b. Fire Support. The AV-8A will generally fulfill fire support requirements currently met by conventional jet attack aircraft. However, the greater responsiveness of forward based AV-8A's to close air support mission requests and the capability to utilize the AV-8A in tactical situations where other fixed-wing aircraft can not now be accommodated may dictate some re-examination of target allocations among fire support systems. The effectiveness of AV-8A delivered ordnance is discussed in Annex G.

c. Logistic Support. Landing force composition and organization will be affected by the engineer support

requirements developed in Annex D, the logistic requirements developed in Annex F, and the capability of the AV-8A to operate with limited logistic support ashore when supported from a Sea Base. The AV-8A is particularly compatible with the proposed Seaborne Mobile Logistic System concept. Future studies of expeditionary airfields must consider the AV-8A basing concepts and requirements.

d. Command and Control. Since the AV-8A will operate within the Marine Air Command and Control System, any study of that system must include consideration of AV-8A command and control as discussed in Annex E. Means, procedures, and equipment will have to be defined if the automation planned for the Marine Air Command and Control System is to be extended to forward based AV-8A's.

e. Intelligence. The AV-8A provides a means of visual and limited photo reconnaissance for the landing force, but means must be provided to process and disseminate information collected by AV-8A sorties. Planning for amphibious operations will require identification of potential AV-8A Main Base, Forward Site, and Facility locations meeting the criteria presented in Annex D, and a knowledge of potential enemy threat to these locations.

403. (U) Recommended Additional Study. Reference (e), which established Project BATTLE CRY for introduction and operational appraisal of the AV-8A, identifies certain factors to be evaluated and requirements to be determined during that project. This study of the AV-8A concept of operation has identified several additional major items recommended for additional study. These are:

a. Definition of procedures, modifications, and additional equipment needed for use and maintenance of the Inertial Navigation and Attack System when operating from Sea Bases.

b. Verification of criteria for AV-8A ship compatibility.

c. Evaluation of the desirability of the Aden gun.

d. Evaluation of the effectiveness of Rockeye II as a close air support weapon.

e. Determination of the requirement, if any, to accommodate electrically fused weapons on the AV-8A.

f. Determination of the requirement, if any, to accommodate guided missiles other than Sidewinder on the AV-8A.

[redacted]

g. Consideration of improved ranging capability to improve accuracy and flexibility of weapon delivery.

h. Development of tactics for use of in-flight thrust vectoring and evaluation of its effectiveness in air-to-air combat.

404. (U) Implications For Future Requirements. Project BATTLE CRY will also refine concepts for high performance V/STOL aircraft employment and aid in defining requirements for future high performance V/STOL aircraft. The concept of operation indicates that high performance V/STOL aircraft provide new capabilities for air support of amphibious operations and should therefore be considered in developing future requirements. The following major implications concerning future requirements can be drawn from this study:

a. Aircraft with multi-mission capability must be examined in light of total Marine Corps aviation requirements and assets.

b. Mission profiles for evaluation of V/STOL aircraft must consider that forward basing may reduce loiter time requirements by substituting ground alert for airborne on-call sorties.

c. Reduced useful load for vertical and extremely short take-offs may well be acceptable, since forward basing and ground alert will reduce mission fuel consumed. More accurate weapon delivery and more effective weapons will allow reduction in payload needed to achieve the desired effectiveness against anticipated targets.

d. Dispersed basing of V/STOL aircraft will place increased emphasis on reliability, self-sufficiency, maintainability, and ability to operate on unprepared surfaces.

e. Shipboard compatibility should be considered in establishing design requirements for future V/STOL aircraft.

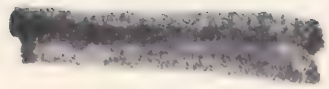
f. Future ship designs, particularly amphibious ships, must consider requirements for operation and support of high performance V/STOL aircraft.

WARNING

This material contains information affecting the National Defense of the United States within the meaning of the espionage laws, title 18, U. S. C. sections 793 and 794. Its transmission or the revelation of its contents in manner to an unauthorized person is prohibited by law.

CLASSIFIED BY ... CMC (AA)
SUBJECT TO GENERAL DECLASSIFICATION
SCHEDULE OF EXECUTIVE ORDER 11652
AUTOMATICALLY DOWNGRADED AT TWO YEAR INTERVALS
DECLASSIFIED ON 31 DECEMBER ... (19)73

[redacted]





[redacted]

(U) ANNEXES

A. Mission Requirements

B. Aircraft Characteristics

C. Ship Compatibility

D. AV-8A Basing

E. Command and Control

F. Logistic Support

G. Weapons Effectiveness

H. Distribution

WARNING

This material contains information affecting the National Defense of the United States within the meaning of espionage laws, Title 18, U. S. C. sections 793 and 794, its transmission or the revelation of its contents in manner to an unauthorized person is prohibited by law.

CLASSIFIED BY CMC (AX)
SUBJ TO GENERAL DECLASSIFICATION
SCHEDULE OF EXECUTIVE ORDER 11652
AUTOMATICALLY DOWNGRADED AT TWO-YEAR INTERVALS
DECLASSIFIED ON 31 DECEMBER 1979

[redacted]

[redacted]

ANNEX A - MISSION REQUIREMENTS (U)

SECTION 1. INTRODUCTION (U)

101. (U) Purpose. The purpose of this annex is to describe the scope of employment of the AV-8A aircraft in support of amphibious operations.

102. (U) General. The employment scope of the AV-8A will be oriented in some measure to the size of the force supported and the nature of the missions appropriate to the force size. The general terms used to describe Marine task organized forces include the Marine Amphibious Unit (MAU), the Marine Amphibious Brigade (MAB), and the Marine Amphibious Force (MAF). Marine Corps Order 3120.3A defines these combat organizations.

103. (U) MAU/MAB/MAF

a. The MAU, due to its size and mission scope, will probably operate without CVA/CVS as a part of the amphibious support shipping. LPH or LHA will normally be available; however, aviation operations may be entirely dependent upon use of nonaviation ships. In any case, AV-8A employed in support of the MAU will likely not disperse ashore in large numbers, and it may be expected that the normal requirement for ashore AV-8A operations will be a Forward Site.

b. The MAB size and mission scope suggest that it is the size force that could most effectively utilize the flexibility that the AV-8A offers as defined in the basing concept set forth in this report. While it is recognized that introduction of the AV-8A provides fixed-wing support, previously nonexistent to the non-CVA/CVS MAU size force, the performance of the AV-8A may be somewhat restricted and a maximum potential may not be realized. Since MAB size force employment would most likely include CVA/CVS as well as LPH/LHA, the AV-8A Sea Base capability will be available.

c. The MAF size and mission scope are not considered to present any unique employment problems, only operations on a larger scale.

WARNING

This material contains information affecting the National Defense of the United States within the meaning of espio laws, title 18, U. S. C. sections and 794. Its transmission or the revelation of its contents in manner to an unauthorized person is prohibited by law.

CL... CMC (AX)
... DOWNGRADED AT TWO-YEAR INTERVALS
... 1974

[redacted]





[redacted]

SECTION 2. MISSION CHARACTERISTICS (U)

201. (U) Types of Missions

a. The mission of the AV-8A squadron, outlined in reference 1, is to attack and destroy surface targets, escort helicopters, and conduct such other air operations as may be directed. Tasks included in this mission are:

(1) Close air support.

(2) Deep air support.

(3) Armed reconnaissance.

(4) Helicopter escort.

(5) Air defense.

(6) Emergency resupply.

(7) Visual and photo reconnaissance.

(8) Psychological warfare.

b. The above missions are described as follows:

(1) Close Air Support. Air attacks against hostile targets which are in close proximity to friendly forces and which require detailed integration of each air mission with the fire and movement of those forces.

(2) Deep Air Support. Air attacks on enemy troops or installations which are at such distance from friendly units as to require no coordination with the fire and movement of those units.

(3) Armed Reconnaissance. A mission with the primary purpose of locating and attacking targets of opportunity; i.e., enemy material, personnel, and facilities, in assigned general areas or along assigned ground communication routes, and not for the purpose of attacking specific briefed targets.

(4) Helicopter Escort. A mission to escort helicopter movements for the purpose of attacking targets that are threats to the helicopter flights.

(5) Air Defense. A mission against hostile airborne targets.

CLASSIFIED BY CMC (AA)
SUBJ TO GENERAL DECLASSIFICATION
SCHEDULE OF EXECUTIVE ORDER 11652
AUTOMATICALLY DOWNGRADED AT TWO-YEAR INTERVALS
DECLASSIFIED ON 31 DECEMBER 1979

[redacted]

WARNING
This material contains information affecting the National Defense of the United States within the meaning of espionage laws, title 18, U. S. C. sections 793 and 794. Its transmission or the revelation of its contents in manner to an unauthorized person is prohibited by law.





[redacted]

(6) Emergency Resupply. The delivery of emergency resupplies to ground units using high speed aerial delivery containers.

(7) Visual and Photo Reconnaissance. A mission undertaken to obtain information by visual observation or photographic devices.

(8) Psychological Warfare. A mission supporting psychological warfare operations to include leaflet drops.

c. The AV-8A role in Marine tactical air support varies according to the task and type of force supported. AV-8A may provide the only fixed-wing air support to a landing force or be used to complement other Marine fixed-wing aircraft. When providing the sole fixed-wing support for a landing force, the AV-8A will be required to perform all functions normally accomplished by other fixed-wing aircraft. When in a complementary role, the AV-8A will be employed primarily on close air support missions. In either case, it can be expected that offensive air support missions will predominate. The frequency of offensive air support missions will predominate. The frequency of offensive air support missions and potential targets are discussed in Annex G.

202. (C) Numerical Requirements

a. A review of historical data and studies, related to attack aircraft requirements, established that support requirements for MAU, MAB, and MAF size forces will fluctuate significantly. The expected threat, mission, location, and duration of an operation directly impacts on the size and composition of the support needed. The availability of land and sea bases and amphibious shipping, however, usually imposes a constraint on what may be provided to satisfy expected needs.

b. An MAU is normally employed to fulfill routine forward afloat deployment requirements and provides an immediate reaction capability to crisis situations. The aviation combat elements of an MAU to support routine deployments usually consist of a composite helicopter squadron. In certain instances, the aviation element may also include an attack squadron and elements of an observation squadron. The attack squadron normally operates from an airfield previously established ashore. To date, aviation elements assigned to support an MAU have conformed to this description. During routine deployments in areas such as the Caribbean, an MAU is normally supported by only a composite helicopter squadron. Whereas, MAU's operating in conjunction with a larger force, such as along the South Vietnam coast, face a greater threat

[redacted]

[redacted]

and are supported by land based fixed-wing MAF aircraft. This range of MAU employments illustrates the flexibility of Landing Force Task Organizations, but also highlights a resultant dilemma when attempting to quantify AV-8A aircraft requirements for supporting these forces. In one case, little or no fixed-wing air support is required, while in more intense warfare, a proportionate slice of an MAF's air support will be required.

c. The most factual statistical study of extended MAU operations in support of the MAF is provided in reference 2. This study by Marine Corps Operations Analysis Group analyzes Amphibious Ready Group/Special Landing Force Operations in Vietnam during the period June 1965 to December 1968. As a part of the study, a statistically "typical" SLF operation is described. These data established that a "typical" landing had a total of 5 days of contact and 2 days of significant contact, and was supported by 28 close air support sorties. Aircraft requirements can be formulated from these data in several ways. If it is assumed that such a typical operation represents the AV-8A close air support demands for an MAU on independent operations, two AV-8A flying at a daily sortie rate of four could satisfy the average requirement of 5.6 sorties per day. If it is assumed that two-thirds of the total sorties will be executed during the 2 days of significant contact, four AV-8A flying at a rate of four sorties per day are required. From this approach, it is shown that average AV-8A requirements for the MAU could range from two to four aircraft. Numerical requirements at the lower end of this range, however, fail to reflect constraints of simultaneous demands and tactical employment. These aircraft should be employed on missions in at least a two-plane section for mutual support and effectiveness, and a four-plane division is frequently required to obtain desired effectiveness against some targets. Additionally, at least two 2-plane sections should be available to provide for maximum continuous coverage on targets when required. From this discussion, it is indicated that a minimum complement of four AV-8A's must be provided to support a typical MAU operation.

d. AV-8A requirements for an MAB appear to center logically on allocating a full squadron to the aviation combat element of this size force. The projected employments of an MAB require that its aviation combat element must be capable of accomplishing all the major functions of Marine aviation in threat environments up to and including mid-intensity. This normally requires that at least detachments from each type tactical squadron must be included in the MAB task organization. The inclusion of an AV-8A squadron in this force is essential to provide for the early establishment of aviation ashore--a capability required for an MAB

[redacted]





[redacted]

organization. Its inclusion also provides for flexibility for sea basing aviation forces on LPH/LHA's should available CVA shipping or land bases be constrained.

e. A specific determination of the number of AV-8A's required to support an MAF is not addressed in this study. It would appear logical that the basing flexibility as provided by the AV-8A would be an essential capability for all Marine Corps aviation force structure requirements and is a task beyond the scope of this study. It is assumed for this study that initial programming will provide one AV-8A squadron for a representative MAF.

WARNING

This material contains information affecting the National Defense of the United States within the meaning of espionage laws, Title 18, U. S. C. sections 793 and 794. Its transmission or the revelation of its contents in manner to an unauthorized person is prohibited by law.

CLASSIFIED BY: CMC (A)
SUBJ TO GENERAL DECLASSIFICATION
SCHEDULE OF EXECUTIVE ORDER 11652
AUTOMATICALLY DOWNGRADED AT TWO-YEAR INTERVALS
DECLASSIFIED ON 31 DECEMBER 1979

[redacted]

[redacted]

(U) REFERENCES

1. U.S. Marine Corps, Table of Organization, Marine Attack Squadron (VMA) 20 Aircraft: AV-8A, T/O M-8859, 22 Jan 73 (Unclassified).

2. Marine Corps Operations Analysis Group, Final Report of Study of Special Landing Force Operations, MCOAG memo 0039-70, 30 Mar 70 (Secret).

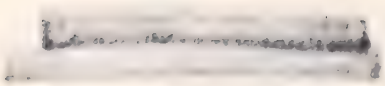
WARNING

This material contains information affecting the National Defense of the United States within the meaning of espionage laws, Title 18, U.S.C. sections 793 and 794. Its transmission or the revelation of its contents in manner to an unauthorized person is prohibited by law.

CLASSIFIED BY CMC (GX)
SUBJ TO GENERAL DECLASSIFICATION
SCHEDULE OF EXEC ORDER 11652
AUTOMATICALLY DOWNGRADED AT TWO-YEAR INTERVALS
DECLASSIFIED ON 31 DECEMBER 1979

[redacted]





ANNEX B - AIRCRAFT CHARACTERISTICS (U)

SECTION 1. AIRCRAFT DESCRIPTION (U)

101. (U) General. This annex presents characteristics of the AV-8A which were considered in developing the concept of operation.

102. (U) Designation. The U.S. Marine Corps V/STOL aircraft has been given the designation of AV-8A. The British designation is HARRIER. The U.S. Marine Corps version is designed for the Rolls Royce Pegasus 11 engine. The description which follows is based on NAVAIR 101B-0601-15A, AV-8A Aircrew Manual (reference 1).

103. (U) General Description. The AV-8A is a transonic, single engine, single seat, vectored thrust aircraft designed for vertical and short take-off and landing (V/STOL). It can perform attack, reconnaissance, and visual air defense missions. It is characterized by a shoulder mounted swept wing, a bicycle type landing gear with outriggers at the wing tips, and two rotatable engine exhaust nozzles on each side of the fuzelage. The Pegasus engine has counter-rotating twin spools to minimize gyroscopic effects. Water injection can be used to maintain thrust for take-off and landing above 40 degrees F. Jet reaction controls provide roll, pitch, and yaw control forces in hovering and low-speed flight. The AV-8A is equipped with five external stores stations--two under each wing and one on the fuselage centerline. In addition, two 30mm Aden machinegun pods can be mounted on the fuselage. Figure B-1-1 shows the general layout of the aircraft. Table B-1-1 presents a summary of design data.

104. (U) Systems.

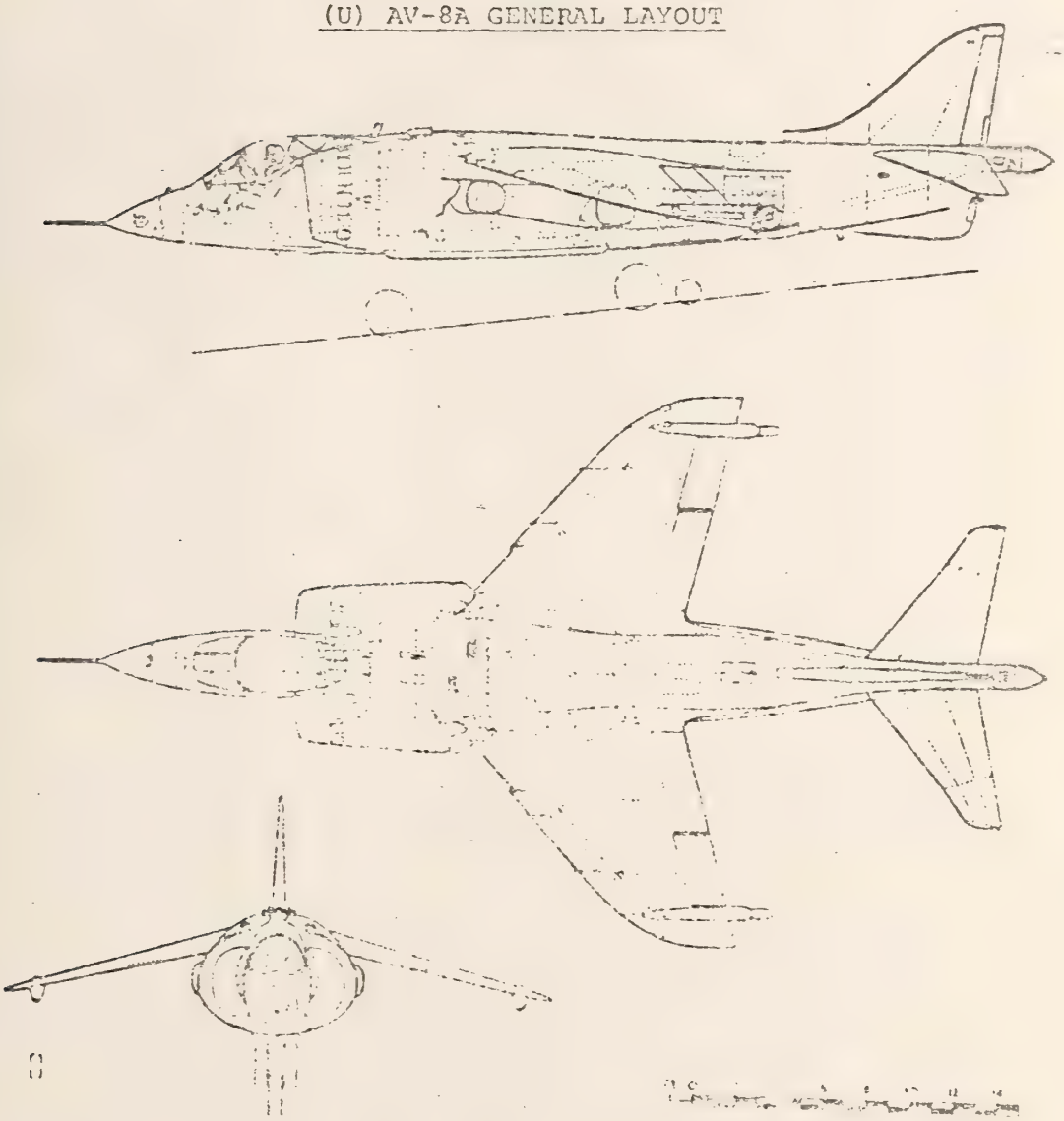
a. Airframe. The airframe is predominantly of conventional aluminum alloy construction, with use made of titanium and stainless steel. The wing is attached to the fuselage at six points and is detachable for engine removal. The aircraft is stressed for 7.5-g maneuvers. The landing gear is designated for a 12-feet-per-second rate of descent and operation on a surface with a California Bearing Ratio (CBR) of 4.0. The nose gear is steered hydraulically up to 45 degrees from the forward centerline, and can be steered up to 179 degrees in either direction for gound handling.

b. Powerplant.

(1) The Pegasus 11 is a twin-spool, axial flow turbo fan engine with thrust-vectoring exhaust nozzles. Each

FIGURE B-1-1

(U) AV-8A GENERAL LAYOUT



spool is independent of the other; they are co-axial, and to minimize gyroscopic effect, they counter-rotate. Engine performance is presented in Section 2 of this annex.

(2) Thrust vectoring is accomplished by rotation of four nozzles actuated by twin air motors and a mechanical drive. Total travel of the nozzles is from fully aft

TABLE B-1-1. (U) AV-8A DESIGN DATA

Overall Length	46 Feet 1 Inch
Wing Span	25 Feet 4 Inches
Overall Height	11 Feet 3 Inches
Wing Area	201 Square Feet
Internal Fuel Capacity	759 US Gallons
Basic Weight	12,140 Pounds
Maximum Gross Weight	22,500 Pounds
Engine	Rolls Royce Pegasus 11
Maximum Speed, Sea Level	600 Knots
Maximum Thrust (Short Lift, Wet)	21,500 Pounds

through 98.5 degrees. Depending on deflection angle selected, the nozzles can be used to provide forward thrust, jet lift, combined thrust and lift, or decelerating force when fully deflected to the braking position. Nozzle deflection is controlled instantaneously by the pilot through the nozzle control lever alongside the throttle. With the lever at the hover stop, the nozzle deflection produces a nose-up attitude for vertical flight. In short take-off (STO), the AV-8A accelerates along the ground with nozzles aft and is lifted off at the desired speed by rotating the nozzles downward to a precomputed angle indicated by setting the adjustable STO stop on the nozzle control quadrant.

(3) At ambient temperatures about 40 degrees F, lift thrust ratings are maintained by use of demineralized water injection to cool the turbine entry stators and blades. Water is delivered to the engine at 350 pounds per minute; the water tank capacity of 60 US gallons allows 90 seconds of operation.

(4) The Jet Pipe Temperature (JPT) limiter prevents JPT from exceeding specified limits by automatically reducing fuel flow and, therefore, engine speed when JPT reaches the temperature associated with maxim thrust or short lift ratings.

(5) The engine life recorder senses JPT and records engine life consumed by operation at lift thrust ratings. The engine life is specified in terms of both operating hours and engine life recorder counts, with the engine being removed when either the specified hours or counts are exceeded. The relationship is such that the operating hours limit is normally reached before the engine life recorder count limit.

c. Flight Controls. Conventional aerodynamic controls are augmented by jet reaction controls for hovering and low speed flight. A master valve interconnected with the engine nozzles provides high pressure bleed air from the jet reaction controls whenever the nozzles are deflected from the full aft position. The master valve is fully open when deflection reaches 20 degrees. Shutter valves controlling the air jets are located at the nose and tail for pitch, the tail for yaw, and the wing tip for roll. These shutter valves are activated by the pilot's normal flight controls. Autostabilization in pitch and roll may be selected at airspeeds below 250 knots to improve handling in low speed flights.

d. Oxygen System. The AV-8A has a demand-regulated oxygen system of 5 liters capacity, adequate for a maximum endurance mission after 4 day's boiloff.

e. Electrical System. Electrical power is provided by two engine-driven generators. The system incoporates two 24-volt batteries and an engine starter/auxiliary power unit (APU).

f. Fuel System. The internal fuel capacity of 759 US gallons can be augmented by carrying external drop tanks on the inboard wing pylons. Pressure refueling at 50 psi is accomplished at 1,200 pounds per minute. An aerial refueling probe can be mounted on the port intake cowling to permit aerial refueling.

g. Armament. The description which follows is based on NAVAIR 101B-0601-15B, AV-8A Aircrew Manual; Weapon System (reference 2).

(1) Two Aden 30mm gun pods can be attached to the bottom of the fuselage. Gun pods are removable and interchangeable between aircraft.

(2) A variety of stores can be accommodated on the four wing stations and the fuselage centerline station. Stores carried on the centerline station are limited by ground clearance and landing gear clearance. AV-8A ordnance stations are currently limited to single stores. For purposes of this study, it is assumed that dual stores carriage will be available on all wing stations.

(3) The weapon control panel enables the pilot to fire, release, or jettison stores; fire guns individually or together; select bomb fuzing; select manual or automatic release; and set bombing interval. It also indicates the

types of stores loaded and selects appropriate ballistic data for the weapon aiming computer.

h. Avionics. The system comprises UHF/VHF (FM) main communications, standby UHF, sound recorder, UHF homer, TACAN, IFF/SSR, and a ground intercom capability.

i. Navigation-Attack. An integrated Nav/Attack system enables the aircraft to be flown with considerable accuracy to a number of selected destinations without recourse to external aids. The system includes an inertial navigation and attack system (INAS) which has a weapon aiming computer (WAC) allowing fully automatic or manual release of selected weapons to be made, with maximum tactical flexibility, against ground targets. The subsystems also include a head-up display and a photographic reconnaissance capability.

SECTION 2. AV-8A PERFORMANCE (U)

201. (U) General. The performance presented in this report for the AV-8A with a mean Pegasus 11 engine is based on NAVAIR 101B-0601-16, AV-8A Operating Data Manual (ODM) (reference 3), and NATC Technical Report FT-27R-72 (reference 4).

202. (U) Engine. The Pegasus 11 performance and limitations summary is shown in Table B-2-1.

a. Lift Ratings. Short lift ratings can be utilized for a maximum of 15 seconds. The short lift rating is based on not reaching stabilized temperatures in the engine turbine. Normal lift thrust can be achieved for an additional 2.25 minutes. Lift ratings can be achieved only with the main landing gear extended or with nozzles deflected more than 16 degrees from full aft.

b. Maximum Thrust Rating. Maximum thrust can be utilized for 15 minutes less duration of use at lift ratings.

c. Maximum Continuous Rating. There is no limitation on use of maximum continuous rating.

203. (U) Take-Off. AV-8A take-offs can be categorized in four classes:

a. Conventional take-off (CTO) in which no thrust vectoring is used and the aircraft lifts off in wingborne flight.

b. Short take-off (STO) in which thrust vectoring is used in combination with wing lift.

c. Rolling vertical take-off (RVTO) in which the aircraft can take off with vectored thrust alone but lifts off with a forward speed of 15 to 20 knots. RVTO is used primarily to avoid debris ingestion and foreign object damage (FOD).

d. Vertical take-off (VTO) in which the aircraft lifts off without wing lift on vectored thrust alone.

204. (U) Take-Off Performance. AV-8A take-off performance is a function of several variables, such as jet pipe temperature, r.p.m., take-off weight ratio (take-off weight/hover weight), air temperature, pressure altitude, and wind. Specific take-off performance in all of the several modes of which the AV-8A is capable is presented in the ODM. Figure

TABLE B-2-1. (U) PEGASUS 11 ENGINE PERFORMANCE AND LIMITATIONS SUMMARY

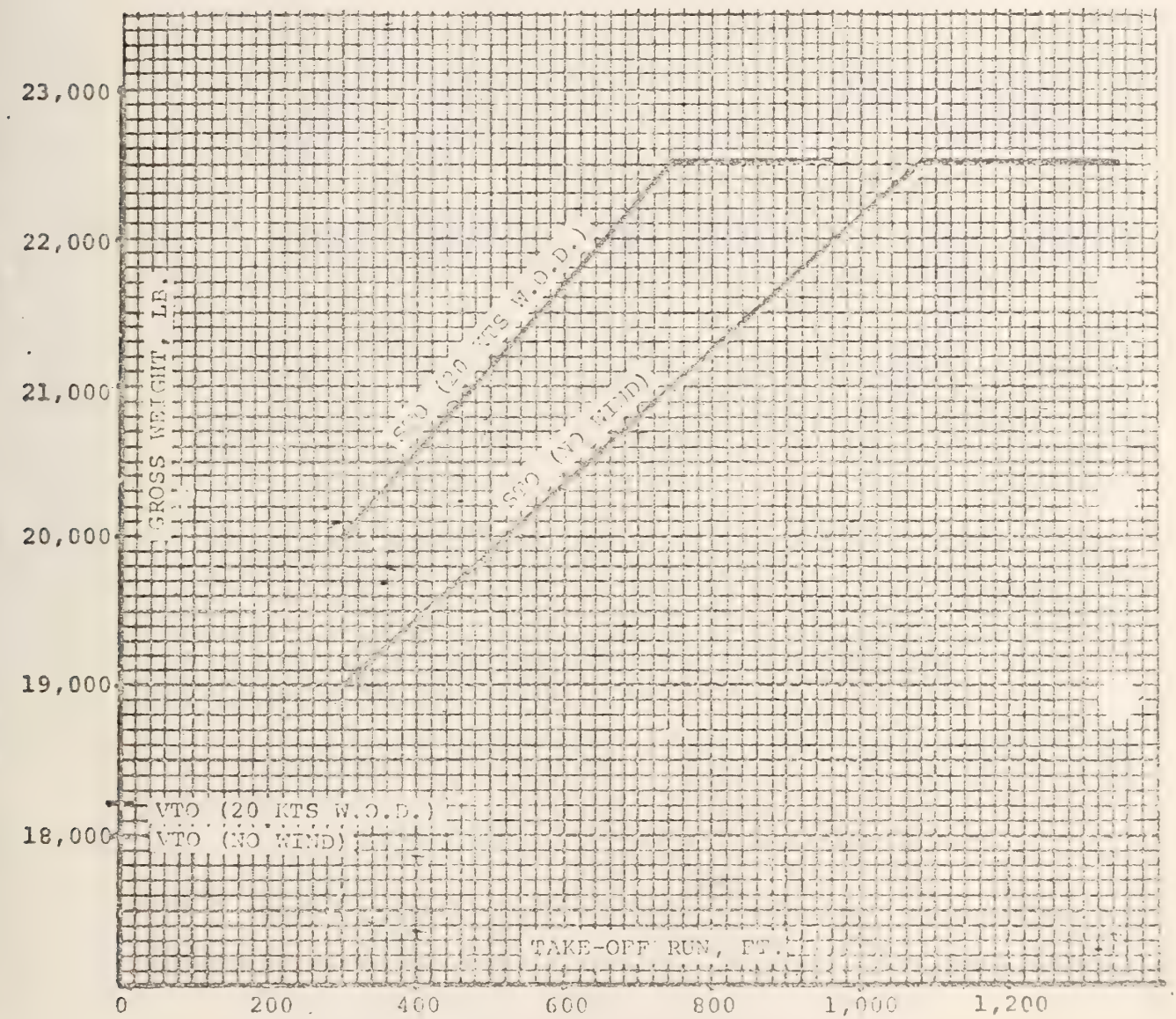
RATINGS	MEAN ENGINE PERFORMANCE (STANDARD DAY, SEA LEVEL) Fan Speed (% RPM)	H.P.C. Speed (% RPM)	J.P.T. (°C)	Gross Thrust	S.F.C. (lb/hr/lb)	Max Fan Speed (% RPM)	Max JPT (°C)	Combined Time Limits
Short Lift Wet	105.0	100.5	635	21,500	0.705	107.0	745	15 secs / 90 secs / 2½ mins / 15 min
Short Lift Dry	102.5	100.0	645	20,500	0.655	103.5	715	
Normal Lift Wet	104.0	100.5	625	21,200	0.700	104.5	720	
Normal Lift Dry	100.0	98.5	615	19,500	0.645	100.5	695	
Max Thrust	94.5	95.5	565	16,750	0.628	95.5	595	
Max Continuous	88.0	01.5	515	13,500	0.618	89.0	525	Unlimited
Ground Idle	16.0	-	-	750	-	25.0 (min)	525	Unlimited

UNCLASSIFIED

UNCLASSIFIED

FIGURE B-2-1

TAKE-OFF GROSS WEIGHT vs. TAKE-OFF RUN
AV-8A STANDARD DAY, SEA LEVEL, SHORT LIFT WET



B-2-1 shows generalized performance for vertical and short take-off utilizing short lift wet ratings.

205. (U) Landing. AV-8A landings can be categorized in four classes:

a. Conventional landing (CL) in which the aircraft touches down in wingborne flight, is normally used only for emergency landings. Landing roll varies from 4,000 to 8,000 feet, depending on landing weight and whether or not nozzle braking is used.

b. Short landing (SL) in which the aircraft touches down with combined wing lift and vectored thrust. Landing roll varies up to 2,000 feet, depending on landing weight.

c. Rolling vertical landing (RVL) in which the aircraft can be flown on vectored thrust alone but touches down with some forward velocity. RVL is used to avoid debris ingestion and FOD or to protect a landing surface. The Aircrew Manual specifies a forward speed of at least 50 knots when FOD potential exists, which requires a landing roll of approximately 500 feet on a dry prepared runway and 750 feet on a wet runway.

d. Vertical landing (VL) in which the aircraft descends vertically on a vectored thrust. The minimum pad size of 72 feet by 72 feet is recommended for normal operations.

206. (U) Mission Profiles. Five mission profiles are used to represent typical AV-8A missions. Figures B-2-2 to B-2-6 show the missions considered.

a. The attack mission represents a round-trip mission with optimum cruise. Mission segments are as shown in Figure B-2-2:

(1) Warmup, take-off VTO or STO, at S.L., 15 degrees C, using 150 pounds water.

(2) Climb to optimum altitude for cruise to target.

(3) Cruise for best range.

(4) Descend at rapid descent rate.

(5) Attack 5 minutes at 5,000 feet at an average speed of 400 KTAS for ordnance delivery.

(6) Climb to optimum altitude for return cruise.

UNCLASSIFIED

FIGURE B-2-2

(U) ATTACK MISSION

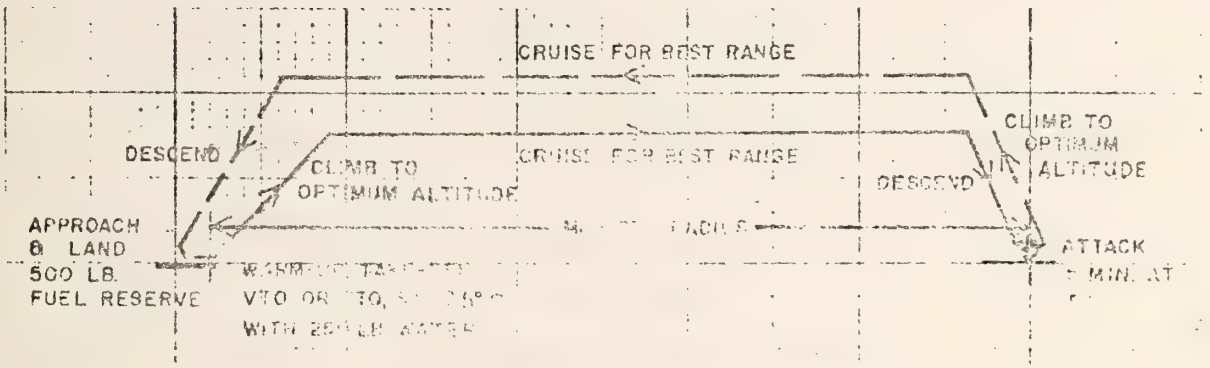
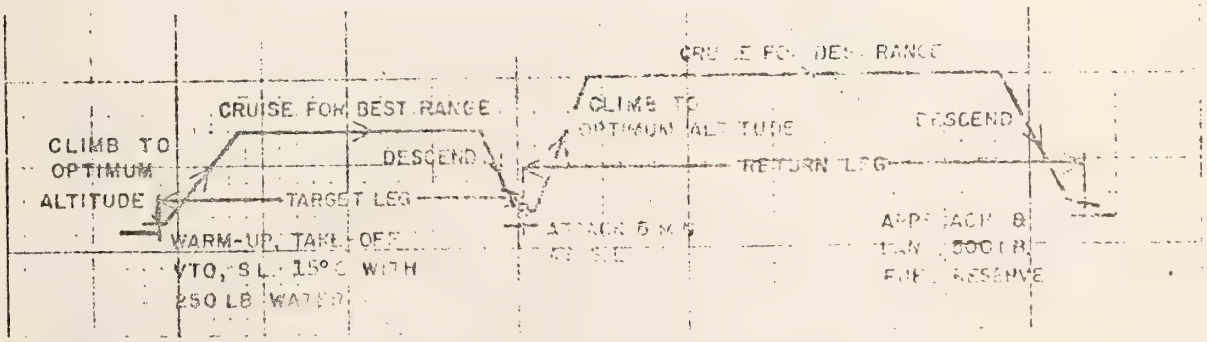


FIGURE B-2-3

(U) SITE-TARGET--BASE MISSION



UNCLASSIFIED

UNCLASSIFIED

(7) Cruise for best range.

(8) Descend at rapid descent rate.

(9) Approach and land with 500-pound fuel reserve at touchdown.

b. The site-target-base mission represents a mission from a Forward Site which returns to a Facility or Main Base. The target leg is the distance from the Forward Site to the target, and the return leg is the distance from the target to the Facility or Main Base. Mission segments are as shown in Figure B-2-3:

(1) Warmup, take-off VTO, at S.L., 15 degrees C, using 150 pounds water.

(2) Climb to optimum altitude for cruise to target.

(3) Cruise for best range.

(4) Descend at rapid descent rate.

(5) Attack 5 minutes at 5,000 feet at an average speed of 400 KTAS for ordnance delivery.

(6) Climb to optimum altitude for return cruise.

(7) Cruise for best range.

(8) Descend at rapid descent rate.

(9) Approach and land with 500-pound fuel reserve at touchdown.

c. The staging mission represents a mission to position aircraft at a Forward Site. If water replenishment is not available, the aircraft must land with water on board for subsequent take-off from the Forward Site. Mission segments are as shown in Figure B-2-4:

(1) Warmup, take-off STO, at S.L., 15 degrees C.

(2) Climb to optimum altitude for cruise distance.

(3) Cruise for best range.

(4) Descend at rapid descent rate.

UNCLASSIFIED

UNCLASSIFIED

FIGURE B-2-4

(U) STAGING MISSION

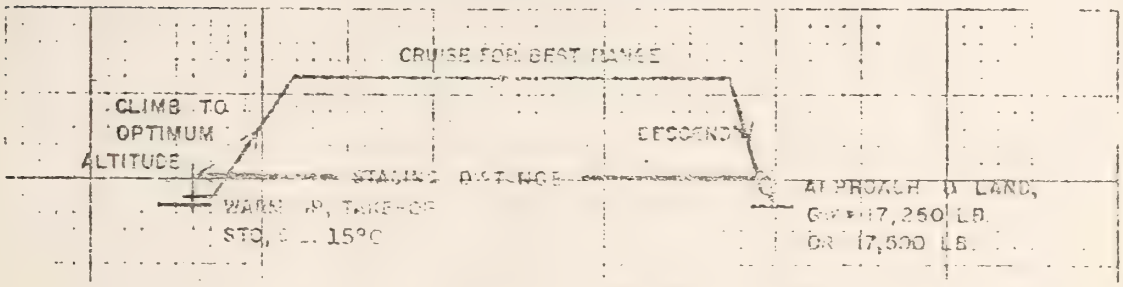


FIGURE B-2-5

(U) INTERCEPT MISSION

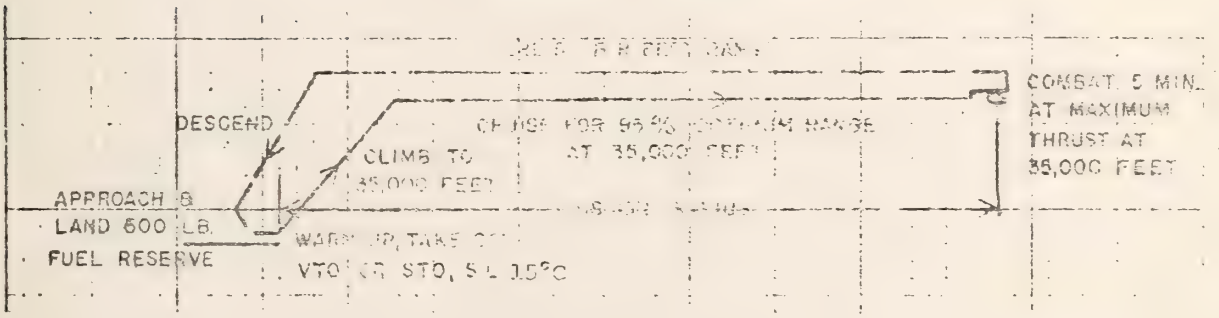
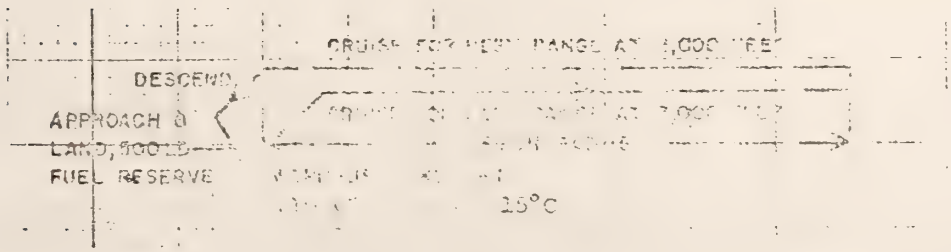


FIGURE B-2-6

(U) ARMED RECONNAISSANCE MISSION



UNCLASSIFIED

(5) Approach and land; it should be noted that the current Aircrew Manual maximum permissable landing weight (except in emergency) is 16,900 pounds.

d. The intercept mission represents an intercept at 35,000 feet. Ordnance load is two AIM-9 Sidewinders and two Aden gun pods. Mission segments are as shown in Figure B-2-5:

(1) Warmup, take-off VTO or STO, at S.L, 15 degrees C, using 150 pounds water.

(2) Climb to 35,000 feet.

(3) Cruise at 35,000 feet at speed for 95 percent of maximum range (fast cruise).

(4) Combat 5 minutes at maximum thrust at 35,000 feet, release weapons payload.

(5) Cruise for best range.

(6) Descend at rapid descent rate.

(7) Approach and land with 500-pound fuel reserve at touchdown.

e. The armed reconnaissance mission represents a low altitude mission at 3,000 feet. Ordnance load is two Aden gun pods. Mission segments are as shown in Figure B-2-6:

(1) Warmup, take-off VTO or STO, at S.L., 15 degrees C, using 150 pounds water.

(2) Climb to 3,000 feet.

(3) Cruise for best range at 3,000 feet.

(4) Return cruise for best range at 3,000 feet.

(5) Descend at rapid descent rate.

(6) Approach and land with 500-pound fuel reserve at touchdown.

207. (U) Mission Data. The following assumptions are made in calculating the performance addressed in paragraph 208:

a. The combination of climb, cruise, and descent is optimized for the distance to be flown, as shown in the ODM, where "cruise for best range" is specified.

b. Temperature is ISA (take-off at S.L., 15 degrees C).

c. Fuel is JP-5 at 6.8 pounds per gallon.

d. Dual stores carriage will be available on all wing stations.

e. Drag index is 2½ per 1,000 pounds of ordnance payload (0 after weapon release), unless otherwise specified in the ODM.

f. Weight data (no fuel, ordnance, or water):

Basic Weight	12,140 pounds
Pilot	180 pounds
4 Pylons	300 pounds
	12,620 pounds

g. When water is used in take-off or landing, the weight of water used is added to the aircraft weight and 150 pounds are consumed per landing or take-off.

h. Fuel used in warmup, take-off, and acceleration is 310 pounds--60 pounds for rapid warmup and 250 pounds for take-off and acceleration--as given in the ODM.

i. Fuel used in approach and landing is 300 pounds, which allows 200 pounds for approach and 100 pounds for rapid decelerating transition and vertical landing, as given in the ODM.

j. Fuel reserve at touchdown is 500 pounds (add to mission fuel requirement).

k. If external fuel is required, two 120-US gallon tanks are utilized.

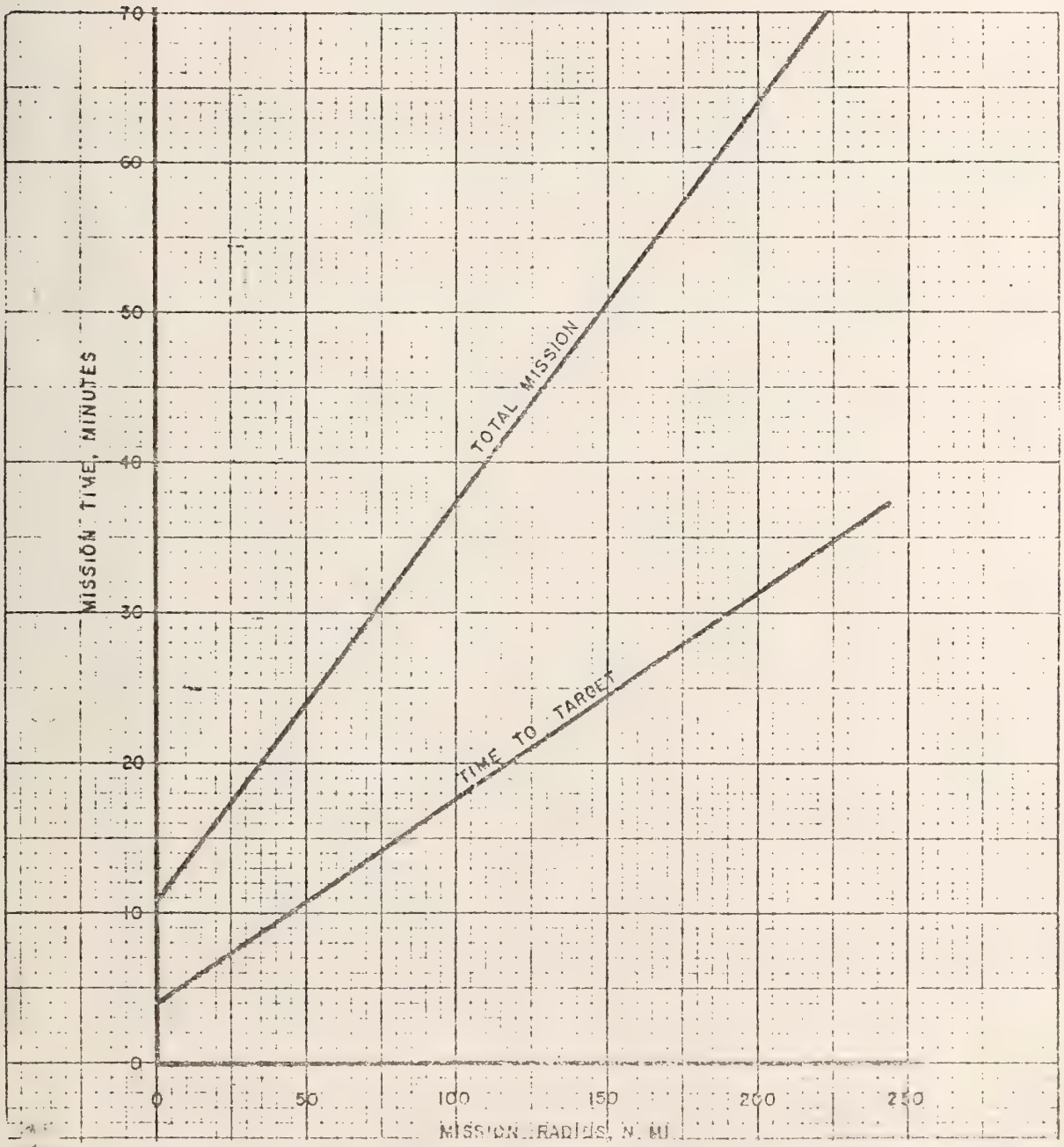
208. (U) Mission Performance.

a. AV-8A mission performance is a function of several variables, such as aircraft configuration, ordnance weight and drag indexes, take-off mode, mission profile, and ambient climatic conditions. Specific performance, in all of the numerous missions of which the AV-8A is capable, is presented in the ODM. Generalized performance is shown in Figure B-2-1 for take-off performance, Figure B-2-7 for mission duration, and Figure B-2-8 for fuel consumption.

UNCLASSIFIED

FIGURE B-2-7

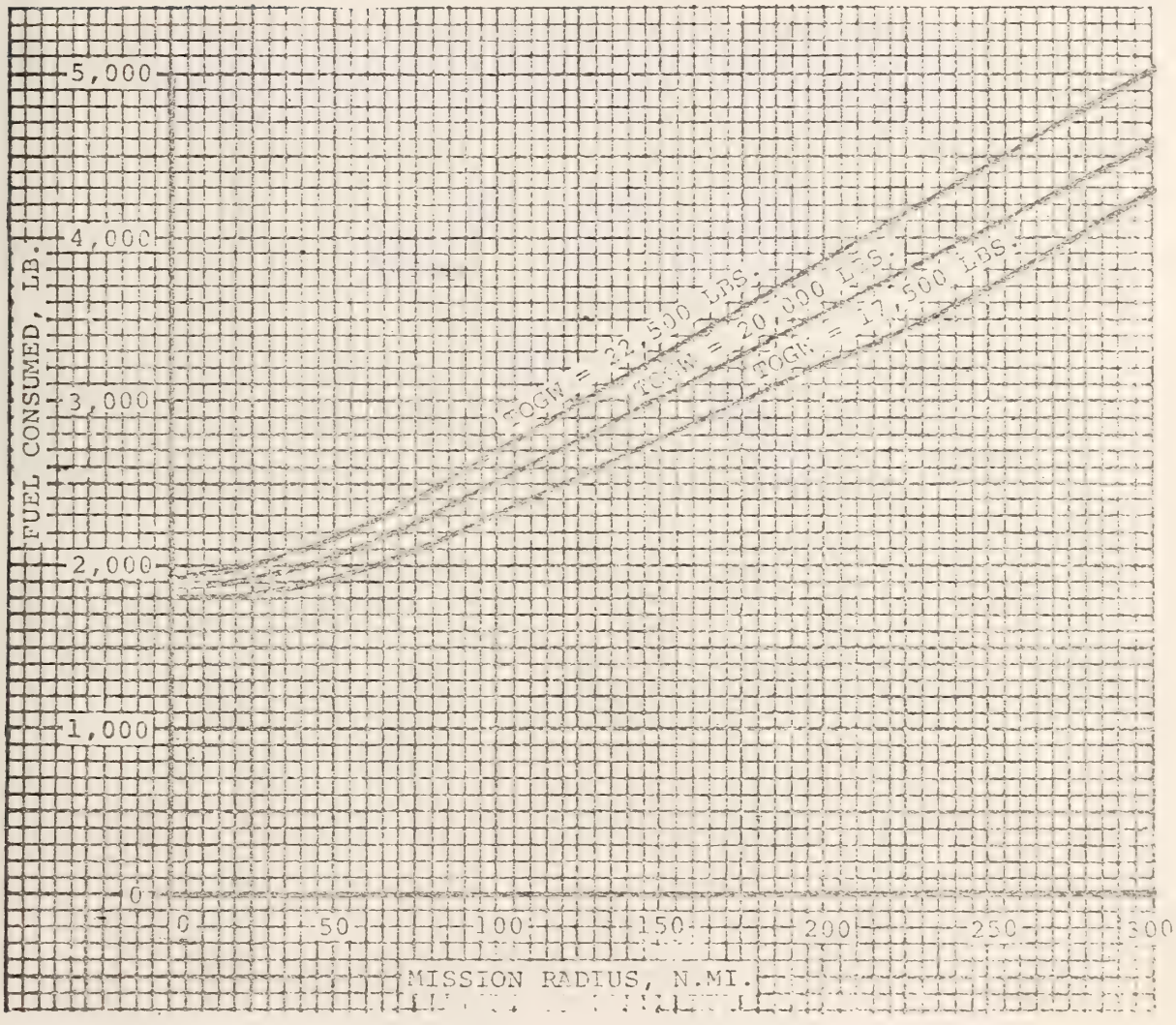
(U) AV-8A HARRIER MISSION DURATION
ATTACK MISSION



UNCLASSIFIED

FIGURE B-2-8

(U) AV-8A HARRIER MISSION FUEL CONSUMED
ATTACK MISSION



b. The following nominal performance missions are used within this report for further determination of basing, logistics, and effectiveness:

(1) At a take-off gross weight of 18,000 pounds, the AV-8A can perform a VTO with a fuel load for a 50-nautical mile mission (1,900 pounds), reach the target in 11 minutes, deliver approximately 3,000 pounds of ordnance, and complete the mission in 24 minutes.

(2) At a take-off gross weight of 20,500 pounds, the AV-8A can perform a 600-foot STO with a fuel load for a 100-nautical mile mission (2,500 pounds), reach the target in 18 minutes, deliver approximately 4,700 pounds of ordnance, and complete the mission in 37 minutes.

(3) At a take-off gross weight of 22,500 pounds, the AV-8A can perform a 1,100-foot STO with a fuel load for a 265-nautical mile mission (full internal--5,154 pounds), reach the target in 39 minutes, deliver approximately 4,600 pounds of ordnance, and complete the mission in 80 minutes.

209. (U) Thrust Vectoring in Flight. Vectored thrust may be used in high speed flight to increase the maneuverability of the AV-8A. The increased maneuverability achieved by rapid longitudinal deceleration and secondarily by increasing normal acceleration adds a new dimension to the air-combat-maneuvering (ACM) environment.

SECTION 3. MAINTENANCE AND RELIABILITY (U)

301. (U) General. This section presents the maintenance and reliability characteristics of the AV-8A and is based primarily on operational data collected and verified during the sortie rate validation test conducted by the Second Marine Aircraft Wing as reported in the Commander Operational Test and Evaluation Force (COMOPTEVFOR), First Partial Report (Task XVIII) of Project P/V2, "Conduct An Operational Appraisal of the AV-8A Aircraft" (reference 5). The terms used in this section are defined as follows:

a. Types of actions:

(1) Maintenance action--work required resulting from all reported malfunctions.

(2) Discrepancy--the degradation of performance of any part of the system to a point beyond its design tolerance.

(3) Failure--a defect which causes a planned mission to be aborted or curtailed after take-off, the use of any emergency system, the use of limited operational procedures, or an accident.

b. Reliability terms:

(1) Mission reliability--the probability that an aircraft will complete a mission of specified endurance without a failure occurring.

(2) System reliability--the probability that an aircraft will complete a mission of specified endurance without a discrepancy occurring (i.e., the probability that no repair action will arise from the mission).

(3) MTBF--mean time between failures.

(4) MTBM--mean time between maintenance actions.

c. Manning terms:

(1) MMH/FH--the ratio of expended productive maintenance man-hours to flying hours.

(2) MO factor--the number of enlisted personnel, by specialty, required to maintain and operate one specific model aircraft for intermediate and organizational level maintenance for a specified flying hour utilization rate.

302. (U) Maintenance Requirements. Maintenance performed on the aircraft, aircraft systems, assemblies, components, modules, and ground support equipment (GSE) is classified into three levels:

a. Organizational maintenance activity (OMA) consists of servicing, lubrication schedules, inspections, troubleshooting, minor adjustments, and replacement of assemblies, modules, and parts.

b. Intermediate maintenance activity (IMA) functions include bench testing; repair of removed assemblies/components within its capability by disassembly, inspection, parts replacement, detailed adjustments, and calibration; and those maintenance actions beyond the scope of the organizational maintenance activity.

c. Depot level maintenance performs major repairs, modifications, and programmed overhaul of aircraft, assemblies, components, and GSE which are beyond the capabilities of the lower levels of maintenance.

303. (U) Scheduled Maintenance. Scheduled maintenance is that maintenance which can be programmed for the life of the weapon system or support equipment. It consists of inspection of specific items or areas on a calendar or hourly basis, also, time replacement items whose failure can be predicted with reasonable accuracy and those components that would comprise safety of flight or cause mission abort. Scheduled maintenance inspections of the AV-8A aircraft are:

a. Turnaround/Servicing. Turnaround maintenance requirements are accomplished prior to the first flight of the day and after each flight during the day. This inspection combines the basic preflight and postflight requirements into a single inspection to insure the integrity of the aircraft for flight. The servicing cards contain requirements for replenishment of fuel, oil, oxygen, and water expended during normal flight.

b. Daily/Special/Conditional. Daily requirements are accomplished prior to the first flight of the day. The accomplishment of these requirements does not satisfy the requirements of the turnaround inspection. These requirements are to inspect for latent defects at a greater depth than the turnaround inspection. Special inspection requirements are added to the daily inspection cards on particular days; special inspections are currently required in 7, 14, 28, 56, and 91-day cycles. Conditional maintenance requirements are dictated by number of events, cycles, or flight hours, or by individual occurrences.

c. Calendar Inspection. A calendar inspection is carried out every 26 weeks.

d. Power Plant Periodic Inspection. Complete engine overhaul is presently required at the expiration of 500 flying hours, but is expected to be extended progressively to 1,000 hours as a result of flight experience.

e. Scheduled Replacement of Components. Certain components are scheduled to be replaced at intervals compatible with scheduled inspection and servicing intervals. Items requiring replacement are identified in the aircraft servicing schedule.

f. Depot Maintenance. Progressive Aircraft Rework (PAR) consists of the necessary restoration, modification, planned examination, and tests which will insure aircraft integrity, reliability, and mission capability for the next planned operating interval. The frequency of this inspection is 24 months.

304. (U) Unscheduled Maintenance. Unscheduled maintenance is work performed to improve, change, or restore aircraft capability by replacement, removal, addition, alteration, or repair of parts without particular regard to flight hours, operating hours, calendar days, or operating periods. The maintenance man-hours/flight-hour demonstrated during the SVRT was 5.1 for organizational and 3.1 for intermediate maintenance and is addressed in reference 5. The MO factors in reference 6, considering both scheduled and unscheduled maintenance requirements at OMA and IMA levels, amount to 14.80 maintenance men per aircraft for a utilization rate of 35 flying hours per month. This is equivalent to 47.3 MMH/FH.

305. (U) Reliability. The aircraft specification specifies a 95 percent probability of completing a one-hour strike or reconnaissance mission (mission reliability), equivalent to a MTBF of 20 flight hours. The system reliability goal is equivalent to an MTBM of 2.92 flight hours. Reliability of the AV-8A was demonstrated during the SRVT by the low number of aborts and the low number of downing events experienced. During the 10-day test, there were 377 sorties launched to achieve 376 completed sorties. This represents a 99 percent mission reliability demonstrated during the test. Of these 377 sorties launched, only 47 downing events occurred during or following a mission. There were only three preflight aborts.

306. (U) Sortie Rate. The sortie rate achievable depends on OR rate, length of operating day, turnaround time, sortie length, and mission reliability. The AV-8A sortie rate is estimated to be between 4.1 and 5.6 sorties per day, for a sustained 30-day period, based on the results of the SRVT and described in detail in reference 5. The sortie length will average 24 minutes (0.4 hours) for a 50-nautical mile radius mission.

307. (U) Manning. Maintenance manning is based on the MO factors developed in reference 6. To this are added the requirements for operations and support personnel to obtain total squadron manning. Table B-3-1 presents a summary of the Table of Organization developed for a 20-aircraft squadron (reference 7).

TABLE B-3-1. (U) SUMMARY OF T/O FOR 20 AV-8A'S

FUNCTION	NAVAL AVIATORS	OTHER OFFICERS	ENLISTED
Headquarters	(9)*	1	8
Operations	32	1	9
Aircraft Maintenance	(5)*	3+(1)*	217
Logistics	(3)*	1+(1)*	29
Medical		1	3
Intermediate Maintenance**			66
TOTAL	32	7	329

* Numbers in parentheses ( ) indicate additional duties for assigned squadron officers.

** Intermediate maintenance section is assigned to headquarters and maintenance squadron of supporting group.

UNCLASSIFIED

(U) REFERENCES

1. NAVAIR 101B-0601-15A, HARRIER MK .50 (AV-8A) Aircrew Manual (Advance Issue), with amendment lists 1 to 21 incorporated (For Official Use Only).

2. NAVAIR 101B-0601-15B, HARRIER MK .50 (AV-8A) Aircrew Manual Weapon System, with amendment lists 1 to 14 incorporated (For Official Use Only).

3. NAVAIR 101B-0601-16, HARRIER Mk .50 (AV-8A) Aircraft, Operating Data Manual, with amendment lists 1 to 3 incorporated (For Official Use Only).

4. NATC Technical Report FT-27R-72, Supplemental Flying Qualities and Performance Trails of the AV-8A Airplane With the F402-RR-401 (Pegasus 103) Engine Installation, Final Report, 5 May 72 (Unclassified).

5. COMOPTEVFOR, First Partial Report (Task XVIII) on Project P/V2, Conduct An Operational Appraisal of the AV-8A Aircraft, 5 Jul 72 (Unclassified).

6. Naval Aviation Integrated Logistic Support Center, Preliminary Report ILS-010R-69, Evaluation of Personnel and Training Requirements for the AV-6B Weapons System (U), 31 Dec 69 (Confidential).

7. U.S. Marine Corps, T/O No. M-8859, Table of Organization, Marine Attack Squadron (VMA), 20 Aircraft: AV-8A, 22 Jan 73 (Unclassified).

UNCLASSIFIED

[redacted]

ANNEX C - SHIP COMPATIBILITY (U)

SECTION 1. INTRODUCTION (U)

101. (U) General. This annex provides the information on ships' characteristics necessary to develop concepts for sea basing of the AV-8A, to determine the impact of these concepts on established shipboard operations, and to ascertain those ship and operational modifications necessary to best utilize the AV-8A in a shipboard environment. Information in this annex was obtained from the AV-8A Ship Compatibility Study conducted by the Aviation Department of the Naval Ship Research and Development Center, Carderock, Maryland.

102. (U) Policy. Although the AV-8A may be capable of operating from many types of ships having a helicopter landing platform, only those ships particularly suited to the unique features and requirements of this aircraft are addressed. Emphasis will be placed on those ships normally found in an amphibious task force which would be instrumental in supporting the AV-8A in a close air support (CAS) role during an amphibious landing.

a. The particular ships' characteristics addressed include:

(1) Maintenance shop space.

(2) Hangar deck dimensions and facilities.

(3) Flight deck dimensions and obstructions.

(4) Billeting spaces.

(5) Administrative spaces.

(6) Fuel storage and handling.

(7) Ordnance storage and handling.

(8) Aircraft servicing facilities.

(9) Communications and navigation equipment.

(10) Crash equipment.

(11) Landing aids and terminal control

b. The above features are considered as they exist on current aviation and nonaviation type ships and what changes

WARNING

This material contains information affecting the National Defense of the United States within the meaning of espionage laws, title 18, U. S. C. sections 793 and 794. Its transmission or the revelation of its contents in manner to an unauthorized person

CLASSIFIED BY CMC (A8)
C-1
DECLASSIFY ON DECEMBER 1983

[redacted]



would be required in order to make them compatible with AV-8A needs.

103. (U) Ship Categories. Two types of ship bases are considered and described in Annex D:

a. Sea Base. Definition: A ship capable of transporting, stowing, and operating a complement of AV-8A aircraft. Rationale: Such a ship must be capable of providing the necessary maintenance, servicing, ordnance, communications, and control required for effective and extended operations.

b. Sea Platform. Definition: A ship which provides a platform for landing and take-off and minimum support. Rationale: All ships on which the AV-8A can land and take off, other than Sea Bases, fall into this category. The AV-8A cannot be based on Sea Platforms for extended periods of time, but Sea Platforms may be used to launch or recover missions. The degree of support provided may vary among classes of ships, but the important distinction between a Sea Base and a Sea Platform is the capability for extended operations.

WARNING

This material contains information affecting the National Defense of the United States within the meaning of section 793, Title 18, U. S. C., sections 793 and 794, the transmission or the revelation of its contents in manner to an unauthorized person is prohibited by law.

CLASSIFIED BY CMC (AX)
SUBJECT TO GENERAL DECLASSIFICATION
SCHEDULE OF EXECUTIVE ORDER 11652
AUTOMATICALLY DOWNGRADED AT TWO YEAR INTERVALS
DECLASSIFIED ON 31 DEC 79



SECTION 2. SHIPS SUITABLE AS SEA PLATFORMS OR SEA BASES (U)

201. (U) Background. The AV-8A sea trials conducted aboard HMS EAGLE (reference 1) have demonstrated that there are no serious physical constraints on AV-8A V/STOL operations from those ship classes specifically designed to operate either fixed-wing or rotary-wing aircraft (i.e., CVA, CVS, LHA-1, LPH-2). The minimum criteria for a nonaviation type ship to serve as a Sea Platform, extracted from reference 2, are described in paragraph 202, below.

202. (U) Landing Area Composition, Size, Obstruction Clearance, and Visual Landing Aids Requirements. In general, the minimum landing area size and obstruction clearance criteria governing all-weather day/night and VFR day/night helicopter operations from nonaviation ships (reference 3) are considered applicable to AV-8A with the following additional constraints:

a. Deck Composition. Operation from decks constructed of wood is prohibited. Although many of these decks are satisfactory from the standpoint of strength, they are not considered suitable for AV-8A operations due to the possibility of deck erosion by the high velocity, high temperature jet efflux and subsequent ingestion of debris into the engine.

b. Approach Clearance Area. The AV-8A jet efflux danger zone in hover extends outward and downward 50 feet from the geometric center of the aircraft. The temperature (50 degrees Centrigade) and velocity (25 feet/second) of the jet efflux 50 feet from the aircraft dictate a personnel-free approach clearance area of a minimum of 100 feet in width centered on the approach line.

c. Minimum Freeboard. In the early stages of this study, a minimum of 25 feet of freeboard, measured from the flight deck, was thought to be necessary to prevent engine ingestion of salt water spray kicked up by jet exhaust during hover. It has been established that jet exhaust can kick up sufficient spray to create a problem from a hover height of 50 feet. The critical conditions, however, are related to a combination of sea-state, wind-over-the-deck, hover height and freeboard height. Sea trials may be required to establish the criteria for minimum freeboard.

d. Minimum Obstruction Clearance. The criteria for an obstruction clear area, in establishing helicopter landing pad size (reference 3), include consideration for the helicopter rotor sweep area. An obstruction free area equivalent to that of at least 1½ rotor diameters is required along the approach to the landing area. In the case of the AV-8A, the

area swept by a distance of 1½ wing spans, or 37.5 feet, between the geometric center of the aircraft and fixed obstructions with the aircraft landing at the most adverse touchdown point on the flight deck is taken as the obstruction free area.

e. Minimum Landing Area Size. Current criteria for the certification of nonaviation ships for all-weather helicopter flight operations are predicated on the helicopter approaching on, or parallel to, an optimum approach line and landing with the front wheel within a touchdown circle of 24 feet outside diamter (22 feet inside diameter).

(1) The minimum landing area size for a specific helicopter is then determined by applying the following criteria:

(a) With the axis of the helicopter on the approach line, the rear wheels, or aft skid extremity, must remain within (determines) the after peripheral marking lines of the landing area when the axle of the forward wheel or forward skid support intersects the after inner edge of the touchdown circle.

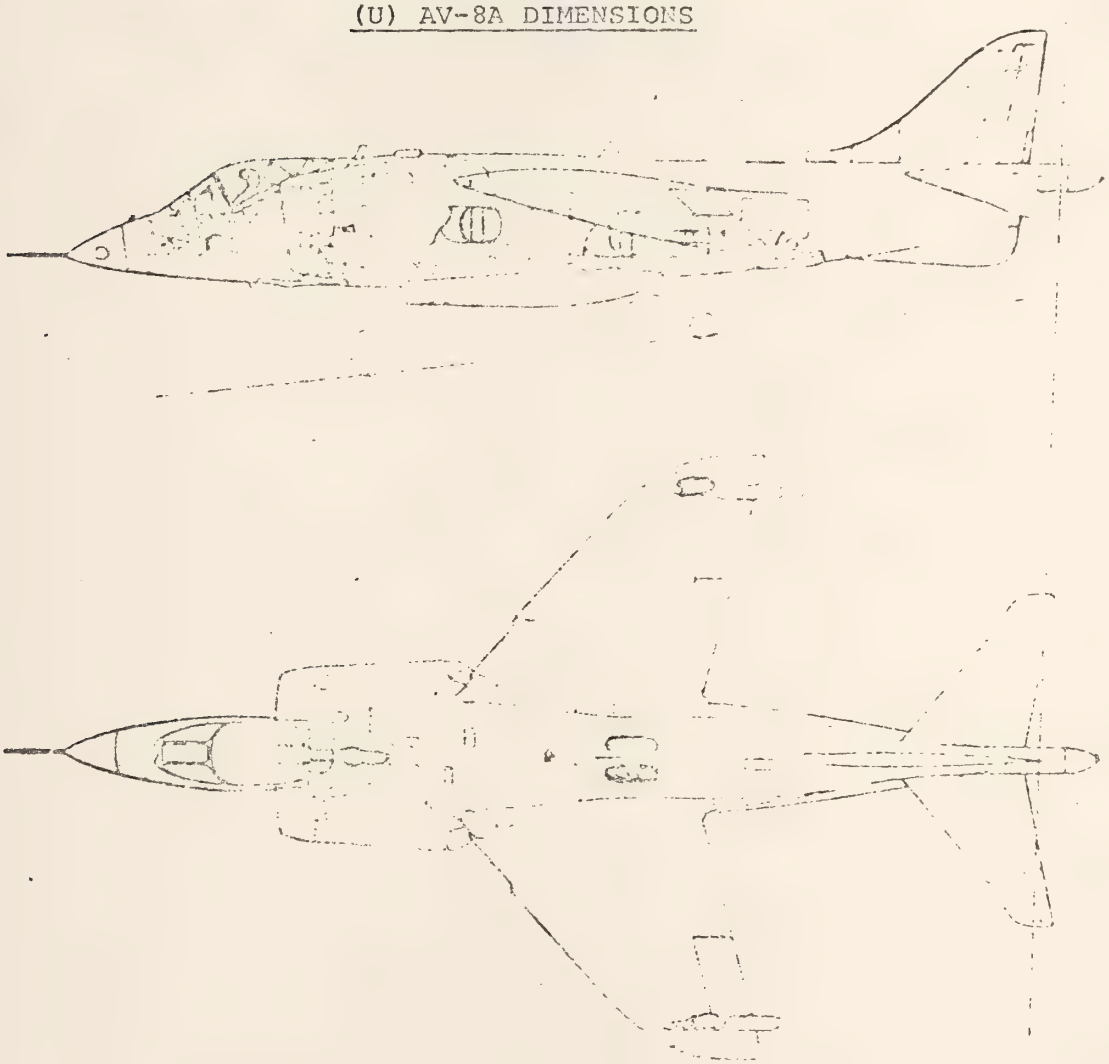
(b) With the axis of the helicopter on the approach line, the ncse of the helicopter must remain within (determines) the forward peripheral marking lines of the landing area when the axle of the forward wheels or forward skid supports intersect the forward inner edge of the touchdown circle.

(2) The touchdown circle of 24 feet outside diameter (22 feet inside diameter) is considered to be suitable touchdown "target" for AV-8A VTOL operations. The minimum operational landing area size can be determined by applying similar criteria to the AV-8A main landing gear/airframe configuration and relevant dimensions. On this basis, the minimum flight deck dimensions required to compensate for undershoot, overshoot, and off-center vertical landings due to pilot technique or ship's motion are (see Figures C-2-1, C-2-2, C-2-3, and C-2-4) 32 feet from the circle center to the aft deck edge line, 38 feet from circle center to the forward deck edge line, and 25 feet to either side from the circle center (i.e., a platform 70 feet long by 50 feet wide). These dimensions define the minimum landing area size, exclusive of obstruction clearance requirements, that will ensure that the AV-8A fuselage, wing tips, and empennage will be within the periphery of the flight deck.

f. Visual Landing Aids Requirements. The criteria for determining the minimum sized landing area required for

FIGURE C-2-1

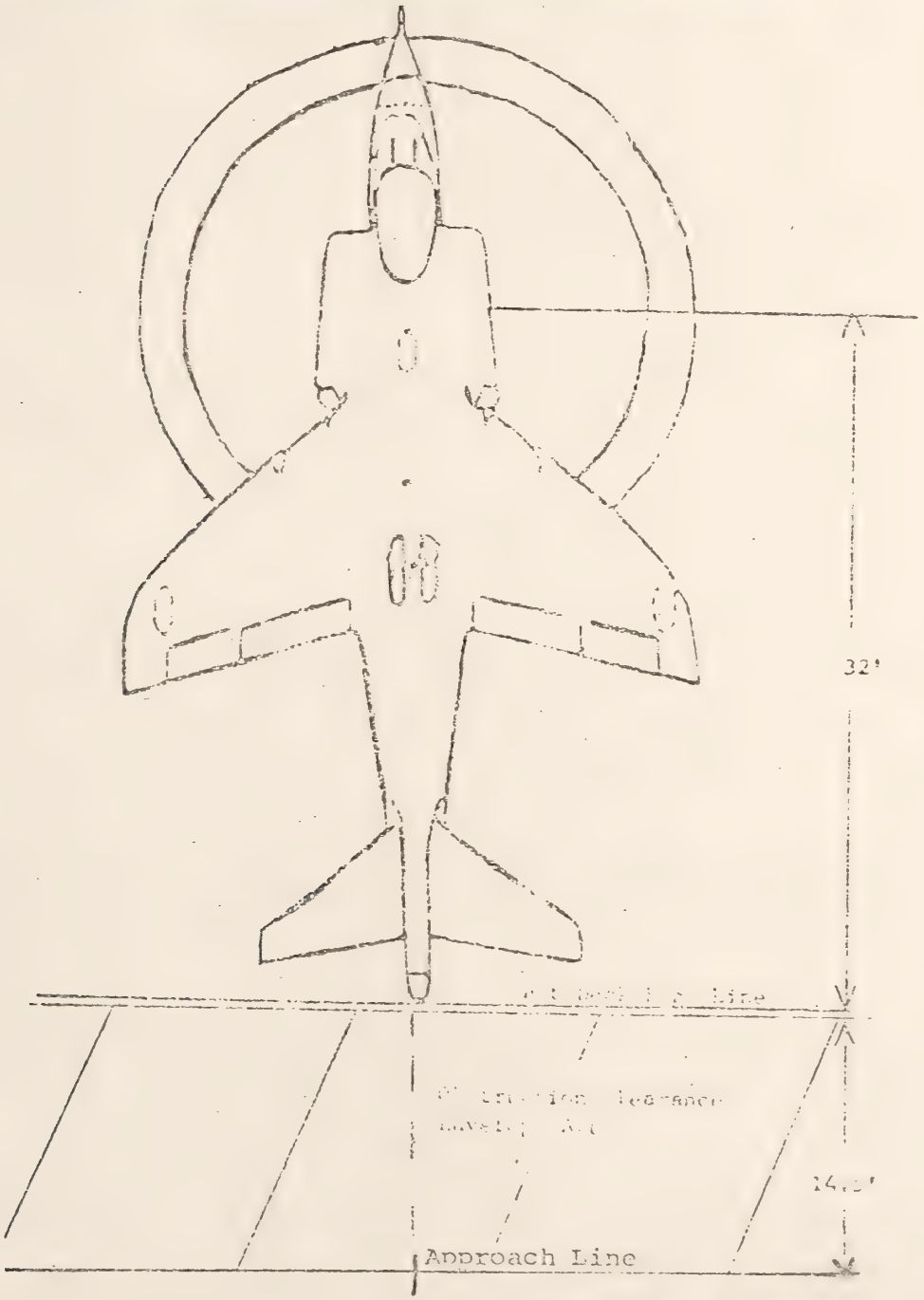
(U) AV-8A DIMENSIONS



Overall Length	46 Ft. 1.0 In.
Wing Span Combat	25 Ft. 4.0 In.
Height (Approx.)	11 Ft. 3.0 In.
Nose to Main Wheels	26 Ft. 0.0 In.
Main Wheels to Tail	20 Ft. 0.1 In.
Outrigger Span	22 Ft. 2.0 In.

FIGURE C-2-2

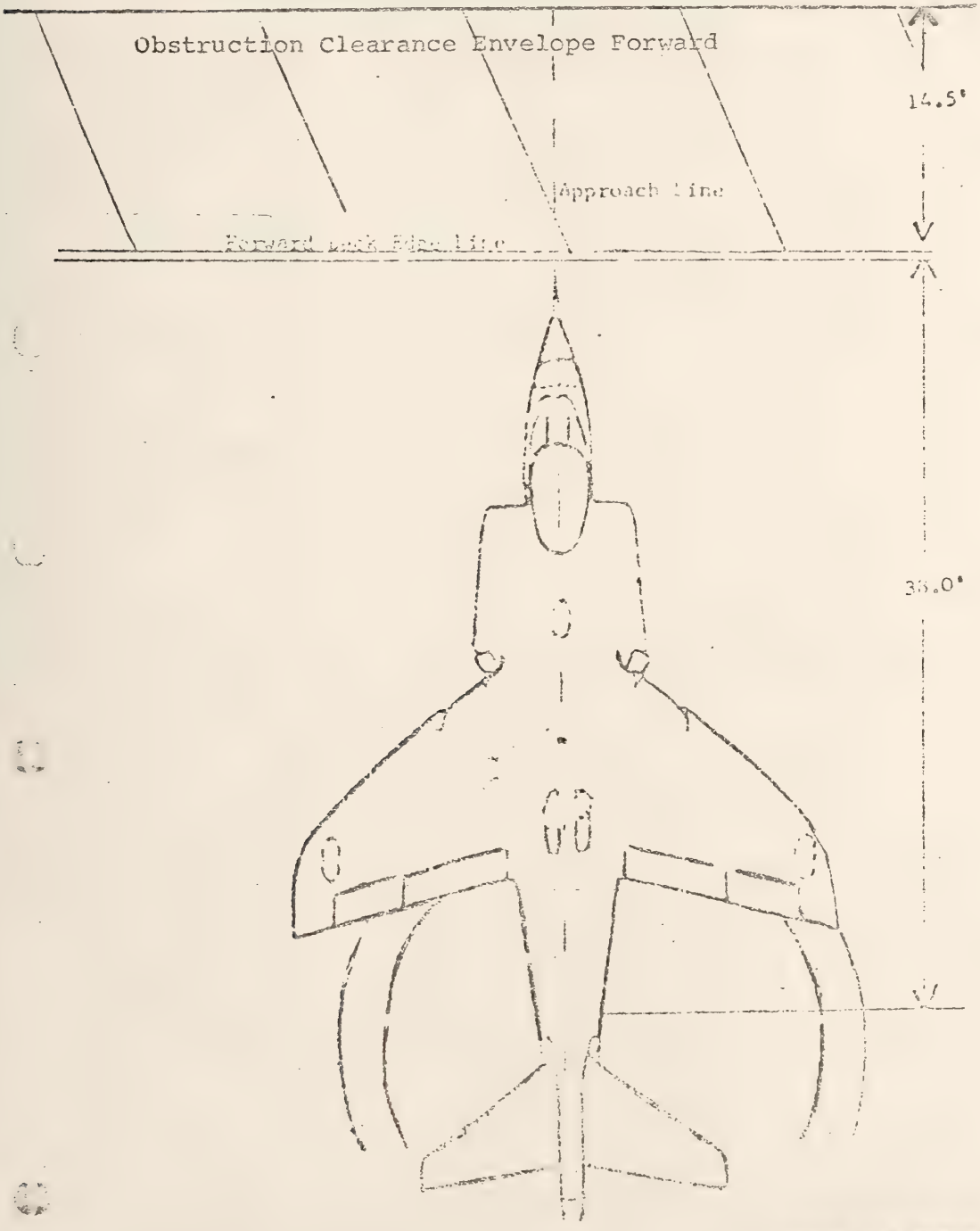
(U) DECK AREA REQUIRED FOR UNDER-SHOOT CONDITION



UNCLASSIFIED

FIGURE C-2-3

(U) MINIMUM DECK AREA FOR OVER-SHOOT CONDITION

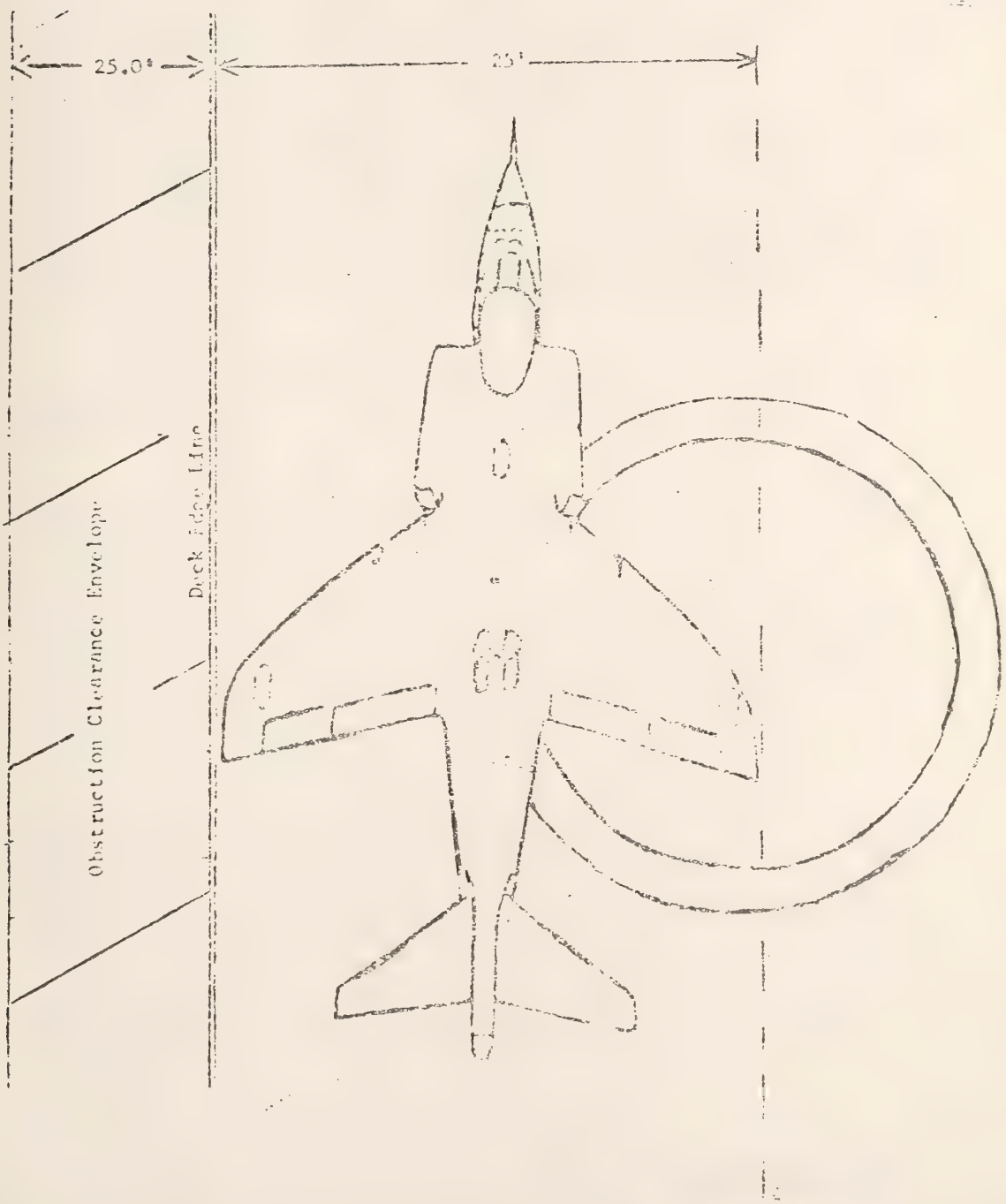


UNCLASSIFIED

UNCLASSIFIED

FIGURE C-2-4

(U) MINIMUM DECK AREA REQUIRED FOR OFF-CENTER CONDITION



UNCLASSIFIED

helicopter operations assume that the helicopter cockpit field of view will enable the pilot to hover over the desired touchdown point by observation of a visual reference on the ship. These same criteria hold for AV-8A landings.

203. (U) Minimum Size of Ships' Landing Platforms. In applying the minimum criteria of paragraph 202, it is recognized that the landing area obstruction clearance envelope and the minimum landing area size will vary with each ship or ship class as a function of flight deck configuration and location, the approach angle selected, the location of the touchdown circle within the available landing area, and the location and height of ship's structure or equipment relative to the landing area. In general, however, it can be stated that the minimum obstruction-free flight deck areas that are physically compatible with AV-8A VTOL operations are:

a. Stern mounted landing platforms 50 feet wide by 70 feet long with an obstacle-free area extending 15 feet beyond the platform boundaries fore and aft, and 25 feet beyond either side.

b. Amidships mounted landing platforms must be 100 feet long, including a 15-foot obstruction clearance area fore and aft, and 50 feet wide with an additional 25-foot obstacle-free area to either side.

204. (U) Flight Deck Strength. The flight deck strength must be adequate to sustain AV-8A VTOL operations at gross weights of 18,000 pounds at a sink rate of 12 feet/second. Additionally, as detailed in reference 3, the combined static and dynamic loads of a secured AV-8A being subjected to the effects of ship motion must be considered in the evaluation of the deck structure.

205. (U) Ships Satisfying Minimum Criteria. The criteria of paragraphs 203 and 204 were applied to the current inventory and planned new construction of Navy ships. Table C-2-1, compiled from references 2, 4, and 5, lists those ship types which satisfy these minimum criteria and thereby qualify to serve at least in the role of a Sea Platform providing that satisfactory visual landing aids are available. Tables C-2-2 and C-2-3, compiled from reference 4, provide a listing of those ships considered, but found wanting, in minimum requirements for AV-8A compatibility.

TABLE C-2-1. (U) SHIPS SATISFYING MINIMUM CRITERIA

SHIP TYPE*	ADEQUATE DECK STRENGTH	ADEQUATE OBSTRUCTION CLEARANCE	FLIGHT DECK DIMENSIONS
LPH-2	X	X	602' x 72'
LHA-1	X	X	797' x 118'
LPD-1	X	X	173' x 78'
LPD-4	X	X	205' x 81'
LSD-36	X	X	77' x 83'
LCC-19	X	X	80' x 78'**
AE-21	X	X	77' x 66'
AOE-1	X	X	83' x 88'
AOR-1	X	X	82' x 85'
All CVA's	X	X	1000' x 250'**
All CVS's	X	X	895' x 190'**

* All ships are typical of their class.
** Average dimensions.

TABLE C-2-2. (U) NONAVIATION SHIPS REJECTED BECAUSE OF INSUFFICIENT LANDING PLATFORM SIZE OR OBSTRUCTION CLEARANCE AREA

AD	14,16,26,37	CGN	9
AE	3,12	CLG	3,6
AF	10,28,48,55,56,58	DD	446,692,710,764,805
AG	153	DE	1022,1037,1041,1051
AGDE	1	DEG	1
AGS	15	DL	4
AKS	1,32	DLG	9,17
AO	105,143	DLGN	33,35
AS	17,33	LCC	11,12,16
ASR	21	LKA	113
CA	68,139	LSD	2,5,13,22,28,30
CG	11	LST	583,1179
DD	963		

TABLE C-2-3. (U) SHIPS HAVING SUFFICIENT LANDING PLATFORM SIZE BUT INSUFFICIENT DECK STRENGTH	
AGS	1
AGMR	1
CC	1,2
LPH	4
LST	1153,1160

SECTION 3. SEA BASE CHARACTERISTICS (U)

301. (U) Background. An AV-8A Sea Base, by definition, must be capable of supporting and operating a complement of AV-8A aircraft. A complement may range up to a full squadron of 20 aircraft. Representative numbers associated with the most likely Sea Base candidates; i.e., the CVA, CVS, LHA, and LPH-2, are shown in Table C-3-1.

TABLE C-3-1. (U) REPRESENTATIVE COMPLEMENT OF AV-8A'S FOR VARIOUS SHIP TYPES

SHIP TYPE	NO. OF AV-8A'S
CVA	20
CVS	20
LHA	10
LPH-2	6

302. (U) Support Requirements. The above numbers are being used for planning purposes in determining how well the various Sea Base candidates provide for the following functions and features which are a must for supporting and operating the AV-8A:

a. Maintenance. Full support requires organizational (OMA) and intermediate (IMA) maintenance activities.

b. Ordnance. Full support requires storage, assembly, and handling of ordnance for four sorties per day per aircraft (Annex B).

c. Fueling. Fuel storage and pressure refueling are necessary for full support.

d. Billeting. Berthing for personnel required to operate, service, maintain, and arm the AV-8A's.

e. Flight Deck or Landing Platform. May or may not provide for rolling take-off and landing as well as vertical take-off and landing.

f. Communications, Control, and Landing Aids. To provide for air support of the landing force--requires

[redacted]

capability to launch and recover AV-8A missions under instrument (IFR) conditions.

g. Replenishment. While the Sea Base must be capable of replenishment at sea, the above features of maintenance, ordnance, and fueling must be sufficient to sustain full-scale operations for a minimum of 5 days without replenishment so as to avoid excessive logistic support requirements.

303. (U) Candidates. The ship candidates to serve as Sea Bases, in the order in which they will be covered, are the LPH-2, LHA, CVS, and CVA.

304. (C) LPH-2 (IWO-JIMA Class). The LPH-2 is a helicopter assault carrier, typical of its class, whose primary mission is to transport and land troops and their essential helicopter-transportable equipment and supplies by means of embarked transport helicopters. Under normal operations, its complement of helicopters can include as many as 27 CH-46's (reference 6). The aviation characteristics of the LPH-2 class are considered, using specific data from the LPH-7 (USS GUADALCANAL). These data are typical of the LPH-2 class except where noted as being otherwise.

a. Maintenance Shop Space. The aviation repair shops are located on the main deck forward of the hangar deck. They encompass an area of 2,377 square feet of deck space which, under existing operational procedure, provides a working area for carrying out organizational and necessary intermediate level maintenance for its complement of rotary-wing aircraft. Accommodations for AV-8A IMA can be provided for, within these shops, with respect to structure, hydraulics, electrical, communication-navigation equipment, and removable engine components.

(1) Vans, 8 by 8 by 20 feet, are ordinarily needed for electrical/avionics IMA. Some of the functions of the vans may be integrated with those normally carried out within the available shop space. If vans are to be utilized, a spotting factor of .25 per van applies when stowed on the hangar deck.

(2) An engine change on the AV-8A requires removal of the wing in order to lift out the engine. The necessary overhead clearance and joists are available on the hangar deck to carry out this task provided the overhead hoists are slowed, in lifting speed, or supplemented with a hand operated chain hoist, so as to accommodate the small clearance between engine and airframe.

[redacted]

[redacted]

b. Hangar Deck Dimensions and Facilities. The hangar deck is 288 feet long with a maximum width of 72 feet, a minimum width of 37 feet, and an overhead of 21 feet. The hangar deck is serviced by two 50 by 34 foot aircraft elevators having a lifting capacity of 44,000 pounds apiece and two cargo elevators, 11 by 7 feet and 17 by 7 feet, with a lifting capacity of 14,000 pounds apiece. There are two overhead hoists with a capacity of 24,000 pounds apiece and four monorail hoists with a capacity of 4,000 pounds apiece. A spotting factor of 1.36 has been established to relate the AV-8A with the CH-46 (reference 6). Using this factor, a tradeoff of AV-8A's and CH-46 helicopter equivalents can be made. Table C-3-2 shows the effect of such tradeoffs.

TABLE C-3-2. (C) MAXIMUM COMPLEMENT OF AV-8A'S AND CH-46 HELICOPTERS ON LPH UNDER NORMAL OPERATIONAL CONDITIONS

AV-8A'S	CH-46
0	27
2	24
4	21
6	18

c. Flight Deck Dimensions and Obstructions. The flight deck dimensions are sufficient for rolling landings and take-offs.

Length	602 Feet
Width (Maximum)	82 Feet
Width (Minimum)	60 Feet (at island)

The island superstructure represents an obstruction but will also serve as a visual reference when landing. The mast height extends to 149 feet above the waterline and can therefore provide the require altitude reference from 60 feet above the flight deck.

d. Billeting Spaces. The introduction of the AV-8A into the aircraft complement of the LPH-2 necessitates also the introduction of special skills, if not extra hands, into the ship's complement of personnel. It is essential to determine if this places an untoward burden on the ship's berthing capability.

[redacted]

[redacted]

TABLE C-3-3. (U) LPH-2 BERTHING SPACES

	OFFICERS	CPO'S & MSGT'S	ENLISTED
Ship's Company	82	34	542
Troops	194	47	1,871*
Others	3	—	28
Maximum Berthing Capacity	279	81	2,441

* Under normal conditions, the enlisted berthings would number 1,587. Under emergency conditions, an additional 284 berths can be made available for a total of 1,871.

(1) The LPH-2 class ship is capable of providing approximately 2,800 berthing spaces (reference 7). The normal breakdown is shown in Table C-3-3.

(2) The AV-8A will require an average of two officers and 16 enlisted men per aircraft for operations, which includes provisions for an IMA operating capability, while each CH-46 helicopter requires an average of four officers and 10 enlisted men to provide for this same capability (reference 8). (While these numbers are subject to some variation as the complement of aircraft is increased, they are close enough to establish whether or not a berthing problem exists.) The reduction in CH-46 equivalents required to make room for the complement of six AV-8A's (Table C-3-2) figures out to an excess of 24 officer berthings and an increased need of six enlisted berthings. The ship's berthing spaces are more than sufficient to accommodate the AV-8A's needs in this area.

e. Administrative Spaces. The aviation administrative spaces amount to 716 square feet (reference 7). Reference 8 shows the support personnel, which includes the administrative personnel, for 10 aircraft to be two men regardless of the aircraft type. The embarkation of an AV-8A detachment should not, therefore, influence the adequacy of the administrative spaces any more than embarking a mix of helicopters.

f. Fuel Storage and Handling.

(1) The LPH has the following capacity for fuel storage:

[redacted]

[redacted]

290,000 gallons of JP-5 @ 95% capacity* (LPH-2,3,7,9)
375,000 gallons of JP-5 @ 95% capacity* (LPH-10,11,12)
* Capacities vary among ships. Capacity given is a minimum.

In Annex F it is established that a representative AV-8A sortie will require 2,200 pounds, or 323 gallons, of JP-5 fuel. For the six aircraft and four sorties/aircraft/day being used for planning purposes, the AV-8A complement will consume 52,800 pounds of JP-5 fuel per day. Each CH-46 transport helicopter, during normal operations, can be expected to use 4,800 pounds of fuel per day. The eight helicopters being removed to make room for the AV-8A complement therefore account for 73 percent of the fuel to operate the AV-8A. Approximately 14,400 pounds of additional fuel would be required for each day's operation and is well within the storage capacity of the ship.

(2) Refueling is provided at a minimum of three fueling stations on the flight deck and one station on the hangar deck. Each station is equipped with a single point pressure fueling system rated at 30 p.s.i.

g. Ordnance Stowage and Handling. The stowage and handling of aviation ordnance (Class V(A)) is a significant consideration when incorporating the AV-8A into the LPH complement of aircraft. The LPH-2 has two cargo holds which are satisfactory for stowage of most types of Class V(A) ordnance. These holds are currently committed to the storage of Landing Force Reserve Material (LFORM) troop munitions with the exception of one compartment which is reserved for the storage of special weapons. The two holds are separated into two vertical levels with each hold being serviced by a cargo elevator which connects it directly with the hangar and flight decks. The hold characteristics are shown in Table C-3-4.

TABLE C-3-4. (U) ORDNANCE CARGO HOLDS ON THE LPH-2

	LOCATION	FLOOR SPACE (SQ.FT.)	VOLUME (CU.FT.)	ELEVATOR OPENING
Cargo Hold No. 1	4th Deck	1,459	11,614	10' x 8'
Pyro/Demo Mag.	4th Deck	207	1,656	
	1st Platform	1,522	12,168	10' x 8'
Cargo Hold No. 2	4th Deck	2,220	17,683	17' x 8'
	*1st Platform	1,926	14,625	17' x 8'

* SASS (Special Armament Storage Space)

[redacted]

[redacted]

TABLE C-3-5. (U) CRITERIA FOR ESTABLISHING ORDNANCE REQUIREMENTS

Deck-Roll	300 Feet (no wind)
No. of AV-8A's	6
Sortie Rate	4
Operating Days	5
Mission Radius	50 NM
Payload - Including Guns	3,380 Pounds
Weapons Mix:	
Rockeyes	62%
MK-82	38%
30mm Guns - All Missions	
Sidewinder Missiles	20 (Estimate)

(1) To establish a representative LPH weapons stowage cube for AV-8A ordnance, data from Annex B (Performance), Annex D (Basing), and Annex G (Weapons Effectiveness) were used. The criteria listed in Table C-3-5 is a summary of the data used to provide ordnance requirements for stowage considerations. To ease the impact of ordnance stowage and handling equipment requirements, the weapons variety was limited to the most desirable weapons as discussed in Annex G. The ordnance payload of 3,380 pounds includes 250 pounds of 30mm ammunition (200 rounds) which are desired for all missions. The external ordnance payload (3,130 pounds) is effectively six stores consisting of Rockeyes and/or MK-82 bombs which the study considers the most effective weapons against the targets envisioned. Additional stowage for a quantity of 20 Sidewinder missiles is desired as a contingency stock for a representative defensive air-to-air capability for the AV-8A.

(2) The AV-8A ordnance mix and volume requirements are listed in Table C-3-6. Under current operational procedure, the SASS (Special Armament Storage Space) hold is restricted to the storage of special ordnance. Exceptions have been made in the past and these holds, or at least holds with similar restrictions, have been used for the storage of air-launched ordnance on CVA's. Reference 9 provides the correspondence related to one such case. When nuclear ordnance is not stowed on the LPH, this space is often used for other purposes, including stowage of conventional ordnance. Figuring on a 5-day cycle, and a broken stow factor of 0.5, the required ordnance storage area is found to encompass 23,468 cubic feet. While the support provided by the AV-8A in an amphibious assault is expected to be considerable, it

[redacted]

[redacted]

TABLE C-3-6. (C) LPH AIR ORDNANCE STOWAGE REQUIREMENTS (6 AV-8A'S)

WEAPON	QUANTITY	CUBIC FEET	STOW FACTOR (.5)	TOTAL VOLUME (CU.FT.)
Rockeye II	446	12,410	6,205	18,615
MK-82	273	2,563	1,286	3,858
30mm	24,000 Rounds	360	180	540*
Sidewinder	20	303	152	455
				23,468

* Estimated

is yet to be established if this will provide sufficient justification for utilizing the SASS hold for air-launched ordnance storage.

(3) A second alternative to providing for air-launched ordnance storage space lies in combining it with the storage requirements for LFORM troop munitions. The usual procedure calls for the LPH to have on hand a 15-day reserve supply of troop munitions with the Marine Landing Force loading another 15-day supply when embarking (reference 6).

(4) A final option is associated with the approximately 22,000 cubic feet of LPH storage space that was once allotted to the storage of AVGAS. This type of fuel is no longer used in quantity, leaving this space available for other purposes. Two possibilities exist:

(a) The most recently constructed LPH-2 class ships; i.e., the LPH-10, LPH-11, and LPH-12, have already been modified with respect to this space. The former AVGAS storage area now provides additional dry storage area. Although dry storage space is not satisfactory for ordnance storage, it is satisfactory for the Class I and IV material (nonexplosives).

(b) The remaining four ships of the LPH-2 class; i.e., the LPH-2, LPH-3, LPH-7, and LPH-9, are currently being considered for modifications meant to utilize the AVGAS space. Reference 10 provides the details for one such proposal in which it is proposed to use this space to provide additional JP-5 storage capacity, additional dry storerooms, and a 9,000-pound elevator to service the storerooms. This modification could serve the ordnance storage

[redacted]

[redacted]

problem as suggested in the previous paragraph, or additional modifications could be included wherein the AVGAS storage space would be converted to an ordnance hold with a cargo elevator connecting it with the hangar deck.

(5) Ordnance assembly is peculiar only to the MK-80 series bomb which requires attachment of the conical or Snakeye fin and fuse. Considering cargo space limitations, this assembly is most easily accomplished in the hangar deck area. Since the Rockeye requires no assembly upon removal from its MK-18 storage container, only unpacking and handling space is required. Sidewinder missiles are stowed in a MK-16 Mod 0 cradle in an assembled configuration except for snap-on fins and wings. The Sidewinder fins and wings are provided in separate pallets. The 30mm Aden gun ammunition should be belted prior to stowage. Therefore, the area considered most desired for ordnance preparation and assembly is the hangar deck area. The required assembly area is approximately 400 square feet. Table C-3-7 lists the general purpose and peculiar ordnance handling equipment required for AV-8A support. The hand tools and aircraft functional checkout equipment will be included in the detachment's OMA capability and are not listed.

(6) The recommended flow of ordnance from stowage area to aircraft loading will consist of the following steps:

(a) Transfer from storage to hangar deck uitlizing forklift and elevator.

(b) Ordnance breakout from pallets (MK-82) and containers (Rockeye).

(c) Weapons placed on Aero 12 B/C skids (MK-82) and Aero 21A skids (Rockeye).

(d) MK-82 tail fins attached and fuse booster and lugs installed.

(e) Weapons transferred on Aero 12 B/C and 21A skids via flight deck elevator to AV-8A loading area.

(f) Weapons manually raised to aircraft attachment points using respective Hernia bars.

(g) Weapon fuzed as required utilizing standard procedures.

[redacted]





[redacted]

TABLE C-3-7. (U) AIR ORDNANCE HANDLING EQUIPMENT

General Purpose Ordnance Handling Equipment	
Forklift*	(2 minimum)
Aero 85 Forklift Adapter with MK-49 Weapons Cradle	(1 per forklift)
Aero 12 B/C Skids	(3 per aircraft)
Aero 9 B/C Adapter	(1 per 2 Aero 12 B/C skids)
Aero 21A Skids	(1.5 per aircraft)
Aero 71A Adapter	(1 per 2 Aero 21A skids)
Peculiar Ordnance Handling Equipment	
MK-81 & 82 Bombs	
- Hernia Bar (Aero 66)	(2 per aircraft)
Rockeye	
- Hernia Bar (MAU 117E)	(2 per aircraft)
- MK-19 Mod 0 Bar	(2 per aircraft)
- Chain/Pneumatic Hoist if stowed without container)	(1)
- Aero 91A Adapter	(1 per Aero 21A skid)
Sidewinder	
- Aero 30A-2 Adapter	(2)
- Aero 8C-1 Adapter	(2)
30mm	
- Extra ammo container for guns	(2 per aircraft)

* Presently on board LPH-2 class ships.

h. Aircraft Servicing Facilities. The following AV-8A servicing/support requirements are provided for on the LPH-2:

(1) Nitrogen.

(2) Electric power.

(3) Air supply.

(4) Demineralized water.

(5) Fresh water for corrosion control.

(6) Aircraft handling equipment:

(a) Wheel chocks.

[redacted]



(b) Chain tie-downs.

(c) Tow tractor.

(d) Tow bar.

(7) Photographic processing capability.

(8) Liquid oxygen (LOX) must be supplied from storage carts. No capacity for generating LOX exists on board ship.

i. Communications Equipment.

(1) The sea basing of the AV-8A should see few problems in the general area of communications. The aircraft system configuration has the following communication complement:

(a) UHF Transceiver.

(b) VHF Transceiver.

(c) VHF(FM) Transceiver.

(d) IFF.

(e) ICS (Inter-Communications System).

(2) The LPH has full UHF transceiver capability, and this equipment provides the main source of air-ground communications.

(3) Communications on deck, between the pilot and Pri-Fly, will normally be through an assigned UHF frequency. The AV-8A's external ICS system may be used between the pilot and deck crew, or relayed to Pri-Fly through one or more of the ship's communication systems (MC-1, -3, -5, or S.P. (sound powered) phones). Hand and/or light signals could provide primary flight deck control of the AV-8A similar to helicopter deck control.

j. Navigation Equipment.

(1) The LPH has several navigation systems that are compatible with the AV-8A. These systems include:

(a) TACAN.

(b) UHF Homer.







[redacted]

(c) UHF/DF.

(d) Radar.

(2) The AV-8A's Intertial Navigation and Attack System (INAS) is not capable of normal alignment aboard ship due to ship's motion. The equipment to facilitate shipboard alignment of AV-8A's INAS requires further investigation.

k. Crash Equipment.

(1) The LPH class ships are currently equipped to deal with aircraft crash emergencies, both from the standpoint of trained personnel and the tools needed to minimize injury and damage. The following equipment is currently available:

(a) Salt water fireplugs, reeled hoses, and applicators.

(b) Fog-foam applicators at the salt water facilities.

(c) Fog-foam generator protected below decks.

(d) Two vehicle-mounted, light water, purple "K" units with dual selective nozzles.

(e) Portable CO_2 extinguishers.

(f) Portable, dry chemical extinguishers.

(g) Crash crane with boom and scraper blade on the flight deck.

(h) Crash and rescue locker.

(i) Two men in hot suits during flight operations.

(j) A sea rescue capability via a motor whale boat ready for launch, a plane guard helicopter or a support ship close at hand.

(2) An airfield-type fire truck has recently been added to the LPH. The truck has CO_2 nozzles at the front bumper and a long over-cab boom applicator that allows fire fighting well within the flame periphery.

l. Landing Aids. The LPH is equipped with landing aids suitable for the requirements of helicopter operation.

[redacted]





They appear suitable for AV-8A operation as indicated in the NATC technical report (reference 1).

(1) The following landing aids exist on the LPH:

(a) LSE (landing signal enlisted) personnel.

(b) LSE wands.

(c) LSE light suit.

(d) Helicopter spot markings.

(e) Homing beacon.

(f) Touchdown zone lights.

(g) Overhead flood lamps, red and white.

(h) Air data measuring system.

(i) Deck condition beacon.

(j) Lineup or approach line lights will not be available on the LPH as existing centerline lights are scheduled for removal.

(2) Initial and final approach guidance may employ one or more of the navigational systems of LPH until the visual landing aids are acquired. This Sea Base capability forms the basis for supporting operations to TACAN/radar minimums.

m. Terminal Control. Terminal control can be maintained using the current air operations doctrine stipulated for LPH class ships. Equipments and properly rated personnel are assigned to control this phase of flight operations in Air Operations Control Center (AOCC), Helicopter Direction Center (HDC), Pri-Fly, and on the deck. LSE stations, if required, will be selected on the basis of operational experience.

n. Miscellaneous. Repair and maintenance of pilot life support equipment peculiar to the AV-8A, such as an oxygen mask, "G" suit, and parachutes, must be provisioned for by the AV-8A detachment because no capability exists aboard the LPH-2.

305. (C) LHA-1 Class. The LHA is designated as a general purpose amphibious assault ship. Its general mission will





[redacted]

be to embark, deploy, and land elements of a Marine landing force in an assault by helicopters, landing craft, amphibious vehicles, and/or combinations of these methods. Reference 6 indicates that a normal operating complement can include up to 38 CH-46 helicopters. The aviation characteristics of the LHA-1 class ships are considered using data made available by the LHA Project Office (PMS-377) and by Litton Systems Incorporated of Culver City, California (the prime contractor).

a. Maintenance Shop Space. There is approximately 4,800 square feet of deck space allotted for aviation repair shops. Most of these shops are located on the main deck in compartments surrounding the hangar. For the projected normal operations, there is sufficient shop space for conducting OMA and IMA for the complement of helicopters on board. Fifty percent of the helicopters can be worked on simultaneously in the hangar with sufficient clearance allowed to move any one helicopter out of the hangar without disturbing the others. IMA level maintenance for the AV-8A presents at least two noteworthy features:

(1) As discussed under the LPH, paragraph 304, service vans may be required for IMA level maintenance of the electrical/avionics system. These vans may be stowed on the hangar deck or in the vehicle stowage area on the third deck. A spotting factor of .25 per van applies if stowed on the hangar deck.

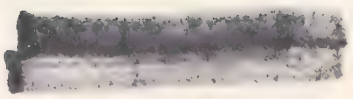
(2) Overhead monorail hoists are available for engine changes although they may require gearing down, or be supplemented by a hand-operated chain hoist, in order to accommodate the small clearance between engine and airframe when extracting the engine.

b. Hangar Dimensions and Facilities. The hangar dimensions are 259 feet by 75 feet, with minimum height clearances of 20 feet forward beneath the gallery deck and 23.5 feet aft beneath the flight deck. Using a spotting factor of 1.36, a trade off between AV-8A's and CH-46's can be made. Table C-3-8 shows the results of these trade offs.

(1) The hangar is serviced by two aircraft elevators: one at the port deck edge, 50 feet long by 34 feet wide, having a capacity of 40,000 pounds; and one at the stern, 60 feet long by 35 feet wide, having a capacity of 80,000 pounds.

(2) In addition to the aircraft elevators, two four-pallet cargo elevators terminate, flush to the deck, on the ship's centerline in the hangar. Each of these elevators

[redacted]





[redacted]

TABLE C-3-8. (C) MAXIMUM COMPLEMENT OF AV-8A'S AND CH-46 HELICOPTERS ON LHA UNDER NORMAL OPERATING CONDITIONS

AV-8A	CH-46
0	38
2	35
4	32
6	29
8	27
10	24
12	21

has a bed 18 feet long by 3.5 feet wide and a capacity of 12,000 pounds.

(3) The hangar will have several overhead hoists which will aid in aircraft maintenance and servicing. They are: a transverse running monorail hoist with two trolleys, one of 8,000-pound capacity and one of 4,000-pound capacity, both with hook clearances of 26.3 feet; a stationary hoist with a 6,000-pound capacity; and four chain falls.

c. Flight Deck Dimensions and Obstructions. The flight deck is of sufficient size to permit rolling landing (dry surface conditions) and rolling take-offs.

Length	797 Feet
Width (Maximum)	118 Feet
Width (Minimum)	65 Feet

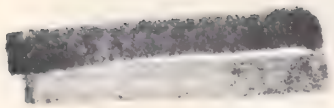
The flight deck is obstructed by the island superstructure, a boat, and an aircraft crane. The island superstructure, however, together with masts extended to 190 feet above the water line on the island, will provide visual reference for vertical take-offs and landings.

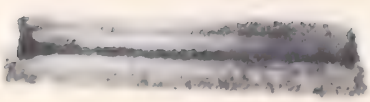
d. Billeting Spaces.

(1) The LHA-1 class ship is capable of providing about 2,500 berths apportioned approximately as shown in Tabele C-3-9.

(2) As established in paragraph 304, the AV-8A requires a complement of two officers and 16 enlisted men per aircraft, for operations, which includes provisions for

[redacted]





[redacted]

TABLE C-3-9. (C) LHA-1 BERTHING SPACES			
	OFFICERS	CPO'S & MSGT'S	ENLISTED
Ship's Company	98	50	762
Troops	175	67	1,725

an IMA operating capability. The CH-46 needs four officers and 10 enlisted men to maintain this same level. The trade off between CH-46 and AV-8A (Table C-3-8) shows the need to delete 14 CH-46's in order to make room for a complement of 10 AV-8A's. The accompanying trade off in personnel shows a reduction of 40 officer's berths and an increase in 10 enlisted berthings. The ship's berthing capacity is more than sufficient to accommodate needs in this area.

e. Administrative Spaces. The air-oriented administrative space planned for the embarked Marine Air Units amounts to about 560 square feet. There will be no difficulty accommodating the two men required for support of the AV-8A in the spaces vacated by the CH-46 personnel.

f. Fuel Storage and Handling.

(1) The LHA has a JP-5 storage capacity of about 400,000 gallons. Assuming that 2,200 pounds, or 323 gallons, of JP-5 are consumed during a typical AV-8A mission, 10 AV-8A's flying four missions each per day will require 12,920 gallons of JP-5 per day. Each CH-46 helicopter will use about 800 gallons of fuel per day during normal operations. Therefore, the 14 helicopters removed to make room for the AV-8A complement account for 87 percent of the fuel to operate AV-8A's. Approximately 1,700 additional gallons of fuel would be required for each day's operation, which is well within the storage capacity of the ship.

(2) Refueling will be provided at six stations on the flight deck (at four stations on the port deck edge and two stations on the starboard deck edge) and two stations in the hangar (one each on the port and starboard side). Each fueling station on the flight deck is equipped with two 150-foot hoses each of which is capable of furnishing 200 gallons of JP-5 per minute at a pressure of 50 pounds per square inch.

g. Ordnance Storage and Handling. The criteria utilized for establishing AV-8A ordnance requirements for the

[redacted]

[redacted]

TABLE C-3-10. (C) LHA AIR ORDNANCE STOWAGE REQUIREMENTS (10 AV-8A'S)

WEAPON	QUANTITY	CUBIC FEET	STOW FACTOR (.5)	TOTAL VOLUME (CU.FT.)
Rockeye II	744	20,609	10,304	30,913
MK-82	456	4,296	2,148	6,444
30mm	40,000 Rounds	600	300	900*
Sidewinder	24	364	182	546
				38,803

* Estimated

LHA are the criteria establishing for the LPH (Table C-3-5) except the number of aircraft is increased from six to 10. These criteria are used to develop the AV-8A's ordnance mix and volume requirements of 33,803 cubic feet outlined in Table C-3-10. Table C-3-11 provides a listing of the LHA cargo holds satisfactory for the storage of air-launched ordnance. These holds, as with the LPH, are currently committed to the storage of LFORM troop munitions with the exception of one compartment which is reserved for the storage of special weapons.

TABLE C-3-11. (U) ORDNANCE CARGO HOLDS ON THE LHA-1

	LOCATION	FLOOR SPACE (SQ.FT.)	VOLUME (CU.FT.)	ELEVATOR OPENING
Cargo Hold No.4	IB*	2,553	24,696	5'8" x 18'
Pyro/Demo Mag.	IB	123	1,238	
	2d Platform	2,546	24,622	
Cargo Hold No.5	IB	2,652	25,640	
	2d Platform	2,639	25,510	
Cargo Hold No.9	IB	746	4,494	
	2d Platform	1,366	13,217	
	2d Platform	897	8,684	
Cargo Hold No.10	2d Platform	2,498	24,156	

* Inner Bottom

[redacted]





[redacted]

(1) The LHA-1 class of ships are being designed to have a highly automated unitized cargo handling system for the rapid striking down or up of palletized Marine Landing Force material. This system is to employ electric and diesel powered forklift trucks, five pallet elevators, an automatic conveyor system, two aircraft elevators, several pallet transporters and a system of 14.5-degree vehicle ramps for facilitating cargo strike up. As envisioned, this cargo handling system appears well suited for the movement of palletized air-launched ordnance. Some features of the cargo handling items warrant additional description.

(a) Electric and diesel powered forklift trucks will be deployed in the unitized cargo holds, break bulk cargo areas, hangar deck stowing area, and flight deck. Two 4,000-pound capacity forklift trucks will be available in the magazines. These trucks should be sufficient for handling and stacking pallets of MK-81, 82, 83, and loaded Rockeye and Sidewinder cradles.

(b) There will be five 12,000-pound capacity pallet elevators having a bed area no less than 18 by 4.5 feet and a clearance height of 5.66 feet. The pallet elevators are located along the centerline of the ship and can automatically load laterally in either direction from an active 18-foot length transfer table. Holds 4, 9, and 10 are each serviced by one of these elevators; hold 5 is serviced by two elevators, fore and aft. All the air-launched weapons pallets currently envisioned for the AV-8A can, in some number, be accommodated on these elevators; weapon skids cannot. The elevator platform will incorporate guide plates, guard coaming, and safety gates to guide and secure pallets on the platform. These platforms shall be suited for the transport of forklift trucks between decks. Pallet elevators 4 and 5 forward and 5 aft operate between the tank top and the third deck, while elevators 9 and 10 operate between the tank top and the hangar deck.

(c) A mechanical conveyor is located on the third deck and shall be capable of transferring 750 pounds/foot (uniform load) between all the elevators at a rate of 60 feet/minute. This will allow palletized ordnance stowed in the forward cargo holds to be transferred to elevators 9 or 10 for carriage to the hangar deck. The conveyor control system is to have both automatic and manual controls. The automatic controls shall provide for stopping of upstream conveyor section during elevator loading or unloading to prevent oncoming pallets from interferring with those being loaded. Manual controls are to be provided to override all automatic functions and to enable the conveyor operators to start, stop, declutch, and brake individual conveyor sections.

[redacted]

[redacted]

(d) The deck edge and port side aircraft elevators are to have a working load of 40,000 and 80,000 pounds, respectively, and a cycle time of 90 seconds. They are considered adequate for transferring ordnance pallets or skids between the flight and hangar decks.

(2) The ordnance assembly and preparation area considered best suited to the LHA is the hangar deck. Palletized weapons will be transported to the hangar deck via transporter vehicles and/or by conveyor. Table C-3-7 lists the general purpose and peculiar ordnance handling equipment required for AV-8A support. A general description of ordnance preparation, handling, and sequential flow to the aircraft is described in paragraph 304.

(3) Trade offs in LFORM and air-launched ordnance or other considerations leading to the availability of various cargo spaces will not be considered here. The assignment of the various cargo spaces is not yet established and the overall cargo space available on this ship suggests that the allotment of sufficient space to accommodate AV-8A requirements will not represent a serious problem.

h. Aircraft Servicing Facilities. The LHA as a general-purpose amphibious assault ship is designed to perform several roles. As a result, the LHA is physically larger than ships of the LPH-2 class. With regard to air-lifting troop and material ashore, the LHA's mission is the same as the LPH's; the LHA, therefore, meets the same servicing requirements as the LPH, but because the LHA is a newer ship with a larger complement of helicopters, its servicing facilities are superior to those found on board the LPH. Paragraph 304 describes the aircraft servicing facilities found on the LPH; they also describe those found on the LHA.

i. Communication Equipment.

(1) No communication deficiencies should be found with deployment of the AV-8A aboard LHA-1 class ships. A centrally-located, computer-controlled system allows automatic selection of functional UHF radio equipment from remote access at various aircraft-control stations. Capacity has been designed and specified to handle full LHA helicopter operation, ship's functions, and control of other tactical fixed-wing aircraft missions assigned to the ship. Adequate redundancy appears to exist.

(2) Ship's internal communications have likewise been designed to NAVAIR and NAVSHIP specifications to allow full simultaneous control of all elements of amphibious

[redacted]

[redacted]

operations to be conducted. If the installed systems meet design specifications, the deployment of AV-8A with any allowable helicopter mix should not reveal any system deficiencies. The systems include the following:

(a) Ship's telephone.

(b) One-way announcing: 1 MC, 3 MC, 5 MC, and 6 MC.

(c) Sound powered phones.

(d) Selectively linked intercom systems.

(e) Warning alarm systems.

(f) Wireless man-on-the-move systems for flight and well deck operations.

(g) Pneumatic tubes.

(h) Voice tubes.

(i) Closed circuit TV.

(3) Loud-speaker systems are specified to perform adequately for ambient noise levels encountered during helicopter operations, a feature probably not attainable with the AV-8A. However, dynamic noise cancelling techniques are a defined design specification for all sensitive equipment.

j. Navigation Equipment.

(1) Equipments installed aboard LHA-1 class ships for aircraft navigation, usable for AV-8A operations, are the following:

(a) TACAN.

(b) UHF homer beacon.

(c) Air search radar.

(d) Height finder radar.

(e) Secondary radar, SIF, IFF.

(f) Carrier control approach radar.

(2) The air search radar will be dual mode with long range target surveillance to 200 nautical miles (one

[redacted]

[redacted]

square meter target) and short range of 15 nautical miles inbound to 200 yards. The carrier-controlled approach radar will provide terminal range, azimuth, and altitude guidance for helicopters operating during meteorological conditions of one-eighth mile visibility and ceiling of 200 feet. The CCA radar will acquire targets between 135 degrees and 315 degrees bearing relative to the ships heading for a stern-on approach (180-degree relative). The height finder radar is designed for all-weather control of friendly aircraft to a range of 50 nautical miles and will be capable of detecting aircraft targets at 120 nautical miles minimum. Both the air-search and the air-search height-finder radars have secondary radar (transponder, IFF) interrogation capabilities incorporated. All data are computer processed for distribution to appropriate user terminals. Together with the sophisticated communication capability of the ship's systems and the necessary controller personnel to man the control stations, any conceivable flight operation for AV-8A should not find a deficiency for which adequate redundance will not exist.

k. Crash Equipment.

(1) The LHA-1 class ships will have remote selective control of flush deck hydrants for salt water and fog foam. They may also have a similar capability for the application of light water controlled from Disaster Control Center (DCC). This system is reported to be the most modern of concept, and as such, it is planned for retrofit on other aviation ships not now so equipped.

(2) Other water agent equipments are pop-up fireplugs at crash and fire repair stations on the flight deck and water curtains in the hangar deck.

(3) Three portable, vehicle-mounted, purple "K" units will be available on the flight deck and can be driven via the vehicle ramps to other decks. Presumably, these systems will have the required redundancy in the form of other portable extinguishers.

(4) The LHA-1 will have a crash crane with capacity in excess of the AV-8A requirements.

(5) The LHA-1 will have a crash and rescue station and two aircraft crash tool kits. Trained personnel, including hot-suit men, will be available to utilize this equipment. Special training may be required to cover certain AV-8A peculiarities.

[redacted]

[redacted]

(6) The sea rescue procedures for LHA are probably not defined as yet, but they can easily pattern those adopted for LPH.

l. Landing Aids.

(1) The visual portion of the landing aids designated for LHA-1 class ships is in agreement with NAVAIR Visual Landing Aids Bulletin No. 6. Installation approval is under the cognizance of NAEC(SI) Code NE 41. Visual aids should be the equivalent of those provided aboard the CVA/CVS type ships, although at present no mirror system (visual approach path guidance) is contemplated for LHA.

(2) Electronic landing aids aboard the LHA-1 class ships include a variety of systems culminating in the SPN-35 radar of the Carrier Controlled Approach (CCA) system. Coupled with trained controllers and the sophisticated communication capability of this ship type, only weather limitations imposed by the aircraft should generate weather minima.

m. Terminal Control. The LHA-1 class ship will have control of the terminal maneuvers divided between the three agencies--flight deck control, Pri-Fly, and (currently) Helicopter Direction Center (HDC). Control procedures equivalent to those of present good practice should be easily attainable. No immediate deficiencies should exist upon the deployment of AV-8A aboard LHA-1.

n. Miscellaneous. As in the case of LPH class ships, no currently planned capability will exist aboard LHA-1 class ships for maintenance of the pilot's personal or support equipment of the types not assigned to helicopter crews. Such equipments are listed in paragraph 304. Extended deployments aboard these ships will require early support planning and implementation.

306. (C) CVS-ASW Support Aircraft Carriers. The general missions of CVS type ships are to support and operate aircraft, to engage in sustained antisubmarine warfare (ASW), to escort convoys, and to provide close air support to amphibious assault and land forces. CVS's are basically CVA type ships which have been converted to conduct ASW as their primary mission. Under normal operating conditions in an ASW role, the CVS will have a total complement of about 43 aircraft of which 27 are fixed-wing and 16 are helicopters. General characteristics applying to all CVS's are presented.

a. Maintenance Shop Space. The maintenance shop space varies from ship to ship, but in all cases, it is in excess

[redacted]

[redacted]

of 3,000 square feet (including work areas in the hangar) and is sufficient to provide the AV-8A with an IMA maintenance capability with the possible exception of the INAS system. Service vans, 8 by 8 by 20 feet, may be required in order to provide this service.

b. Hangar Dimensions and Facilities. The hangars on the CVS class ships are about 700 feet long by about 80 feet wide. The hangar decks are serviced by three aircraft elevators of about 55 by 45 feet in size with about 46,000-pound capacities, and up to five bomb elevators of about 5,000-pound capacity.

c. Flight Deck Dimensions and Obstructions. The flight deck dimensions are sufficient to permit rolling landings and take-offs. The approximate dimensions are:

Length	895 Feet
Width (Maximum)	190 Feet

Some of the ships of this class have wooden decks with steel inserts in the landing area, under the arresting wires, and at the forward edge of the straight deck. The forward edge of the canted deck has a metal area which makes up the elevator platform. The location of these metal inserts is significant since they may make AV-8A operation feasible on an otherwise unsatisfactory deck (i.e., wooden deck). The steel pad in the landing area is approximately 100 feet long by 40 feet wide and could suffice for VTOL operations while the elevator platform would be capable of withstanding exhaust impingement on nozzle deflection at the end of an STO roll. The metal pad, forward on the straight deck portion, is not large enough to provide significant protection from the impingement of jet exhaust at the end of an STO take-off roll. STO operations, without modifications to those ships of the CVS class having wooden decks, would be restricted to the angled deck. As with the CVA and LPH, the island superstructure represents an obstruction, but the superstructure along with a mast about 190 feet high above the waterline will provide visual reference during V/STOL operations.

d. Billeting Spaces.

(1) The approximate berthing distribution for the CVS is shown in Table C-3-12. The number of berths used by the air detachment varies with the number and type of aircraft on board.

(2) The aircraft in the usual ship's complement are of equal sophistication and require a similar level of

[redacted]



TABLE C-3-12. (C) CVS BERTHING SPACES		
	OFFICERS	ENLISTED
Ship's Company	100	1,775
Maximum Berthing Capacity	334	2,830

support as the AV-8A. Hence, AV-8A presence should not affect the berthing situation any more than any other aircraft.

e. Administrative Spaces. The administrative spaces vacated by ASW personnel would be sufficient for AV-8A requirements.

f. Fuel Storage and Handling.

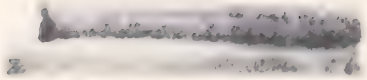
(1) The JP-5 storage capacities on the CVS class vary from ship to ship through a range from 450,000 gallons to 750,000 gallons. The minimum quantity in this range should be sufficient for at least 5 days of operation of all the ship's aircraft.

(2) Refueling is accomplished at between 40 and 100 pounds per square inch at flow rates up to 200 gallons per minute. The number of fuel stations on the flight deck varies from 12 to 17, and in hangar from 5 to 6.

g. Ordnance Storage and Handling. The CVS ships which are considered for their air-launched stowage and handling capabilities are CVS-11 and 14. Both of these ships were originally ESSEX class aircraft carriers and, therefore, have many of the same characteristics. Prior to their conversion to CVS, these ships underwent modernization to enable them to operate with high performance jet aircraft. The air-launch ordnance stowage volume on both CVS-11 and 14 is of the order of 90,000 cubic feet. On both ships this volume does not include the rather large ordnance handling and ready service areas (mess deck, hangar deck, flight deck) on the upper decks. In references 14 and 15 (for CVS-11 and 14, respectively), space is designated for the storage and handling of Mark 80 series bombs, Sidewinder missiles, Sparrow missiles, and 2.75 and 5-inch rockets. These spaces are fitted for universal or modular stowage of these weapons and, in most instances, require the pallets to be broken down and the weapon components individually stowed on their respective racks. Although no space is designated for the all-up -







[redacted]

Rockeye II pallet stowage on either of these ships, sufficient magazine space could be made available for the bare stowage of these weapons in the universal bomb magazines. In contrast to the more recent CVA's and amphibious ships, the magazine decks on the CVS-11 and 14 are not designed for fork-lift truck movements or heavy palletized stowage. However, air-launched weapons magazines have the appropriate hoists for the handling of individual weapons from their particular racks to bomb skids. Since these ships are primarily designated for ASW taks, much of their air-launched ordnance space is not being used. Although the exact volume of unused magazine space is not known (at this writing), the indications are that the addition of air-launched ordnance for a good number of AV-8A's would not seriously restrict cargo spaces for ASW and other equipment. Adequate space for Aero 12 B/C and Aero 21A skids is available, and it appears that most of this equipment is present on the CVS-11 and 14 ships.

h. Aircraft Servicing Facilities. All required servicing facilities are available on board CVS's with the possible exception of nitrogen on some of the ships.

i. Communication Equipment. The communication equipment on board CVS class ships is extensive and should be compatible with AV-8A requirements. Paragraph 304 provides a satisfactory discussion for CVS capabilities.

j. Navigation Equipment. (See paragraph 304.)

k. Crash Equipment. (See paragraph 304.)

l. Landing Aids and Terminal Control. (See paragraph 304.)

307. (C) CVA-Attack Aircraft Carriers. The general missions of CVA type ships are to support and operate aircraft, to engage in attacks on targets afloat and ashore which threaten our control of the sea, and to engage in sustained operations in support of other forces. HANCOCK class CVA's (CVA-19 and CVA-34) are omitted from this discussion. The data given for CVS's in paragraph 306 apply to these two ships. The CVA represents the best aircraft Sea Base in the world. The CVA, in general, meets or exceeds all requirements of the AV-8A aircraft.

a. Maintenance Shop Space. CVA's have aviation maintenance shops capable of fully servicing AV-8A. Total aviation shop area is in excess of 10,000 square feet.

[redacted]

b. Hangar Dimensions and Facilities. The hangars on CVA's are approximately 650 feet long by 95 feet wide. The hangars on CVA-41, 42, and 43 are serviced by three aircraft elevators; all others have four aircraft elevators. The elevators are at least 56 feet long by 44 feet wide with a minimum capacity of 46,000 pounds. The hangars are also serviced by at least five bomb elevators of about 5,000-pound capacity.

c. Flight Deck Dimensions and Obstructions. The flight deck dimensions are approximately:

Length	1,000 Feet
Width (Maximum)	250 Feet

As with other aviation ships, the island superstructure is both an obstruction and visual reference for vertical flight operations. All flight decks (including CVS's) are equipped with two catapults forward and as many as two or more catapults on the angled portion of the flight deck. Each catapult is fitted with a jet blast deflector which may be used in conjunction with AV-8A rolling take-offs. The run obtainable from the blast deflector to the deck edge varies from 220 feet to about 350 feet. The length of the angled deck is between 520 feet (for all CVS's and some CVA's) and 760 feet.

d. Billeting Spaces.

(1) The approximate berthing distribution for CVA's is shown in Table C-3-13. The number of berths used by the air detachment varies with the number and type of aircraft on board.

TABLE C-3-13. (C) CVA BERTHING SPACES

	OFFICERS	ENLISTED
Ship's Company	132	2,622
Maximum Berthing Capacity	421	4,505

(2) Trading AV-8A aircraft against other types of attack aircraft should not result in a significant change in the number of berths required, since the aircraft are at comparable levels of sophistication.

[redacted]

e. Administrative Spaces. No change in the number of administrative spaces required will occur if AV-8A's are traded against other aircraft.

f. Fuel Storage and Handling.

(1) The JP-5 storage capacities of CVA's varies from ship to ship between 635,000 gallons and 2,470,000 gallons. The average JP-5 capacity for CVA's, excluding the CVA-19 and CVA-68 classes, is 1,500,000 gallons. (The CVA-19 class JP-5 capacity is discussed under CVS's. The CVA(N)-68 class has not entered service; hence, actual data are not available.)

(2) Refueling may be accomplished at six stations in the hangar and 13 stations on the flight deck. Fuel flow rates are from 150 to 250 gallons per minute and fueling pressures are from 30 to 45 pounds per square inch (p.s.i.). CVA-19, 34, 41, 42, 43, 59, 60, 61, 62, and 64 have fueling pressures equal to or greater than 40 p.s.i. and, hence, are capable as configured of fueling the AV-8A. The remaining CVA's, the 63, 65, 66, and 67, fueling systems are capable of providing the proper fueling pressure (between 40 and 60 p.s.i.) if the minimum pressure regulating valve in the JP-5 service system is either reset or replaced.

g. Ordnance Storage and Handling. The CVA ordnance discussion is based mainly on CVA-67 (references 13 and 14). References 15 through 18 indicated, along with references 13 and 14, that most of the air-launch ordnance facilities on all the attack carriers (KITTY HAWK, FORRESTAL, MIDWAY, and HANCOCK class) are very similar. On the CVA-67 there are some 66 storage areas designated for the stowage of air-launched ordnance and ordnance handling equipment. Most of the magazines are configured for the modular stowage of air-launched weapons, as for example, Mark 80 series bombs, Rockeye, Sidewinder, Lau 69/A, Walleye, Bullpup, and CBU 24.29 magazines. The modular stowage requires weapons being broken out of their palletized strapping or containers and stowed in appropriate storage racks or bins. The air-launched ordnance magazine capacity appears to be of the order of 350,000 cubic feet for CVA-63, 64, 66, and 67 (KITTY HAWK class) and 135,000 cubic feet for CVA-41, 42, and 43 (MIDWAY class). These examples serve to show the magnitude of the attack carrier's magazine space and do not include the proportionally large dry stowage areas which can stow bomb fins, skids, bomb racks, and other miscellaneous ordnance parts and equipment. If we assume that an even trade off of 20 A-4E aircraft with 20 AV-8A aircraft was made, more than adequate ordnance space would be available

[redacted]





[redacted]

on CVA ships to satisfy AV-8A ordnance requirements. The special handling equipment which would include Aero 12 B/C skids and Aero 21A skids with all adapters necessary for handling Mark 80 series bombs, Rockeye II, Sidewinder missiles, 2.75 and 5-inch rockets, and many other weapons, yet to be cleared for the AV-8A, are present in sufficient number on the active CVA ships.

h. Aircraft Servicing Facilities. All required servicing facilities (as set forth in paragraph 304) are available on CVA's.

i. Communication Equipment. Aboard the major aviation ships, the AV-8A would constitute another A-4 type aircraft unit except for payload, range, and cycle type. The numerous ways in which flight operations ultimately will be affected by deployment of AV-8A aboard CVA's is presently the subject of must discussion. Flight experience in the United Kingdom aboard HMS EAGLE, as reported by USMC observers, does not suggest that communication capabilities, now existing, would need any modification to accept AV-8A deployment.

j. Navigation Equipment. Equipments aboard CVA are adequate for AV-8A operations, with the possible exception of INAS alignment. The equipment installed in AV-8A may not be compatible with alignment equipment installed in the ships.

k. Crash Equipment. Equipments aboard CVA are adequate for AV-8A operations.

l. Landing Aids. The landing aids aboard CVA are probably adequate for AV-8A operations. However, consideration should be given to such supplements as a dual mirror system (port and starboard), additional island lighting, and special hover guidance. Additions to the present complement of ship's equipment may shorten the deck time necessary to complete an operation, thereby lessening problems of aircraft mix.

m. Terminal Control. Adequate terminal control exists aboard CVA with the current mix of aircraft. Introduction of AV-8A may require that the aircraft spotters handle the aircraft prior to touchdown in the manner of an LSE. For least disruption, the AV-8A should attempt to fit into current procedures, rather than to modify the procedures for the aircraft.

n. Miscellaneous. Full capability exists aboard CVA for maintenance of the pilot's personal and support equipment.

[redacted]





[redacted]

SECTION 4. SEA PLATFORM CHARACTERISTICS (U)

401. (U) Background. An AV-8A Sea Platform, by definition, is a ship which provides a platform for landing and take-off and minimum support of the AV-8A. The level of support can vary significantly among the various candidates, ranging from a low level, where the ship would serve only as a staging point, to one in which a complete turnaround, including re-arming, could be provided. In order to establish the level of support that may be expected from each ship class, the ship characteristics to be addressed will be as extensive as with the Sea Bases.

402. (C) LPD-1 (RALEIGH Class). The LPD-1 is an amphibious transport dock, typical of its class, whose primary mission is to transport and land troops and their essential equipment and supplies by means of landing craft or amphibious vehicles augmented by helicopter lift. Under normal operations, no helicopters are permanently assigned to the LPD. The LPD-1 class is considered using specific data from the LPD-3 (USS LASALLE). These data are typical of the LPD-1 class except where noted as being otherwise.

a. Maintenance Shop Space. An aviation repair shop and storeroom with 210 square feet of deck area is located on the main deck. Additional shop space may be made available, for emergency maintenance, in other shops on board (metal, 504 square feet; carpenter, 200 square feet; electrical, 150 square feet; electronic, 288 square feet; and battery, 300 square feet).

b. Hangar Dimensions and Facilities. There are no hangars on LPD-1 class ships.

c. Flight Deck Dimensions and Obstructions. Flight deck dimensions are given in Figure C-4-1. The flight deck is unobstructed except when the vehicle ramp is in use. The ship's snaking equipment, used for pulling vehicles up the ramp, obstructs the forward helicopter landing spot. Forward of the flight deck, the ship's superstructure limits the approach and departure paths of aircraft and may generate air turbulence in the flight deck area if operations are conducted while the ship is underway. The superstructure, however, should provide good visual reference for the AV-8A during landing and take-off.

d. Billeting Spaces.

(1) The LPD-1 class ship is capable of providing about 1,400 berths apportioned as shown in Table C-4-1.

[redacted]

CONFIDENTIAL

FIGURE C-4-1

(U) LPD-3 FLIGHT DECK DIMENSIONS



TABLE C-4-1. (U) LPD-1 CLASS BERTHING SPACES

	OFFICERS	CPO'S & MSGT'S	ENLISTED
Ship's Company	60	34	516
Troops	74	26	756
Maximum Berthing Capacity	134	60	1,272

CONFIDENTIAL

[redacted]

(2) The average number of enlisted personnel required for operation and IMA for one AV-8A is established at 16. It appears safe, then, to assume that a similar number of personnel would suffice for the less demanding task of providing turnaround service at a level of four sorties per day. These personnel would only be embarked on the ship for the extent of AV-8A operations to provide for flight line maintenance, servicing, and ordnance handling. They should present no problem to the ship's berthing capacity.

e. Administrative Spaces. There is no administrative space designated for aviation personnel. However, a turnaround capability does not require administrative support.

f. Fuel Handling. Adequate facilities for fueling the AV-8A are present on LPD-1 class ships. The ship's JP-5 capacity is about 225,000 gallons with about 17,000 gallons in ready service tanks. Single point pressure refueling is accomplished at 50 p.s.i. from two fueling stations at the starboard edge of the flight deck, one station adjacent to each landing spot.

g. Ordnance Storage and Handling. The LPD-1 class ship holds considerable promise as a Sea Platform with an AV-8A turn-around capability. A turn-around capability includes provision for rearming. The LPD-1 has satisfactory space for the storage of air-launched ordnance to provide this service. Table C-4-2 shows the characteristics of those cargo compartments which are satisfactory for the storage of most classes of air-launched ordnance. These compartments are currently committed to the storage of LFORM or special weapons. In the VTO mode, the AV-8A is capable of taking off on a 50-nautical mile radius mission with an ordnance load of 3,000 pounds (Annex B). For planning purposes, it will be assumed that the aircraft ordnance load consists entirely of guns and four Rockeyes per sortie. On

TABLE C-4-2. (U) ORDNANCE CARGO HOLDS SERVICED BY WEAPONS CARGO ELEVATORS ON LPD-1 CLASS SHIPS

HOLD LOCATION	FLOOR SPACE (SQ.FT.)	VOLUME (CU.FT.)	MINIMUM CLEARANCE	ELEVATOR OPENING
1st Platform	1,768	13,260	7'8"	7' x 8'
2d Platform	687	5,083	7'9"	7' x 8'
Special Weapons Magazine	956	9,072	9'6"	7' x 8'

[redacted]

[redacted]

the basis of a 5-day supply, this amount of ordnance would require a total of approximately 2,100 cubic feet including a stowage factor of 0.5. Since the passageway leading from the flight deck to the cargo elevator is only 7 feet wide on the LPD, during strike down, a forklift truck cannot transport the MK-18 Rockeye (9.5 feet) and MK-16 Sidewinder (11.4 feet) cradles from the flight deck to the cargo elevator stations. The Aero 21A skid with 57A and 91A adapter, however, is capable of transporting these weapons' cradles. The breakout and assembly area for the limited number of air-launched weapons could be positioned easily on the LPD in either the lower vehicle stowage area, upper vehicle stowage area, or mess deck. This area is expected to be less than 200 square feet. Table C-3-7 lists the handling equipment required for MK-82 bombs, Rockeyes, and Sidewinder missiles.

(1) The restrictions on use of the SASS hold for other than special weapons are similar to those existing on the LPH and discussed in that section. However, as stated there, it is established that air-launched ordnance is compatible in storage with "special" weapons (reference 9). The 2,100 cubic feet required for the air-launched ordnance would leave about 7,000 cubic feet for the storage of special weapons. In any case, since many low key missions do not require the use of "special" weapons, this cargo space is often unused and could, therefore, serve to support AV-8A operations.

(2) The LFOFM troop munitions could be eliminated from the second platform cargo compartment leaving this space for the air-launched ordnance.

h. Aircraft Servicing Facilities. The following AV-8A service requirements are available, or can be provided for, on the LPD-1:

(1) Liquid oxygen (LOX); must be supplied by storage bottles, no capacity for generating LOX exists on board ship.

(2) Nitrogen; must be supplied by storage bottles.

(3) Low pressure air.

(4) Electric power.

(5) Fresh water.

(6) Aircraft handling equipment:

[redacted]



(a) Wheel chocks.

(b) Chain tiedowns.

(c) Pad eyes.

(d) Tow bars.

(7) Demineralized water.

i. Communication Equipment.

(1) The contemplated Sea Platforms for use during AV-8A operations are mostly nonaviation type ships possessing some aviation capability. Ships designated "nonaviation" fall, subject to qualification and inspection, under the specifications established by CNO and CNM instructions. Paragraphs "i" through "l" of this paragraph and subsequent paragraphs have requirements that are documented in considerable detail in literature resulting from the above instructions. Capabilities in the ship that are not of the performance standards established prevent the ship from being certified for a specific level and class of aircraft type operation, except under a waiver status.

(2) The complement of radio communications listed for the LPD-1 class is:

(a) UHF.

(b) VHF.

(c) HF.

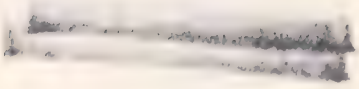
(d) LF.

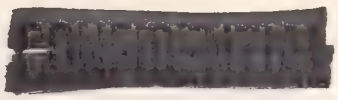
(e) FM.

(3) The complement of ship's internal communications for the conduct of flight operations are both audio and visual. Announcing systems 1 MC and 3 MC are in the LPD-1 class complement, as are sound-powered phones to various control stations. Visual signals include deck condition beacon and Captain's ready deck signal. Other audio communication systems constitute the signal alarms to various stations. Within specific ships, some of the certifiable capability may not exist.









j. Navigation Equipment.

(1) Navigational facilities inspected and certifiable for use aboard the nonaviation ships are TACAN and low-frequency homing beacon (for LF-ADF). LF homing beacon is not applicable to the complement of navigation equipment installed in AV-8A. Although UHF homing beacon facilities are installed and used aboard LPD's, the CNO does not specify them as "primary" navigation equipment, since UHF equipment aboard some aircraft do not allow simultaneous comm/nav operation. The interruption of one function to achieve the other apparently represents an unacceptable limitation for less than VFR operation, the initially planned operational spectrum for AV-8A. However, the significance of UHF homing beacon being designated "nonprimary" is that functional test of the system is not a responsibility of the NAVAIR inspection teams, and is thus not evaluated for deployment planning. The deploying operator should determine operational status for each planned deployment during which UHF homer use is intended.

(2) All RALEIGH class LPD's indicate TACAN facilities are installed.

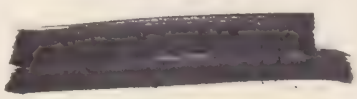
(3) Air search radar in the ship is not an inspection item for the NAVAIR aviation facilities inspection teams, and thus no functional reports are available. However, radar provides a very important navigational tool for which ship's procedures are specified in CNO documentation. Although it has not been positively established for all radars, the LPD has transponder interrogation (SIF-IFF) for positive target identification. It is presumed that all LPD-1 class ships have the capability coordinated with their primary air search radar system.

(4) No inertial navigation alignment capability now exists aboard LPD-1 (RALEIGH class).

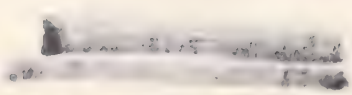
k. Crash Equipment.

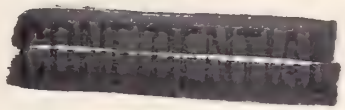
(1) The LPD-1 (RALEIGH class) has designated crash equipment suitable to handle crash emergencies of the AV-8A, with the possible exception of special tools, peculiar to that aircraft and crash of an aircraft with ordnance aboard. Initially, these conditions should be considered by the deploying operator and coordinated with the appropriate ship commands.

(2) Generally applicable emergency criteria are defined within the ship certification standards under a paragraph entitled "Safety." Available equipments are









listed in the Facilities Resume under the headings of "Fire Fighting" and "Safety." Adequacy of the systems is only established through inspection by the NAVAIR inspection teams.

(3) The LPD-1 has the following complement of fire fighting and safety equipment related to the flight operations area:

(a) Salt water fire plugs.

(b) Fog-foam.

(c) CO_2 bottles.

(d) All-purpose nozzles.

(e) Applicators.

(f) Bayonet applicators.

(g) Two hot suits.

(h) Safety nets.

(i) Air/sea rescue locker.

(j) Crash and rescue kit.

(4) A more detailed definition of the equipments and their peripheral gear is contained in the certification standards. Although not listed, the LPD-1 is known to have a crash crane with scraper blade capable of handling the AV-8A.

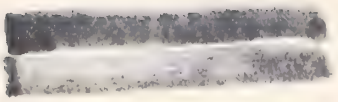
(5) Ordnance plans now published for the LPD class ships will probably be inadequate for the aviation stores carried aboard the AV-8A. Pending an ordnance handling safety plan for the AV-8A type of ordnance, few if any specific guidelines exist for establishing LPD capabilities in this critical area.

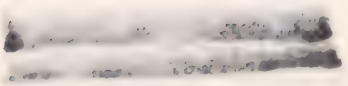
1. Landing Aids.

(1) The LPD-1 (RALEIGH class) is equipped with landing aids suitable to the requirements for helicopter operation. The following list of lighting and visual landing aids has been determined as being available on the LPD-1:

(a) Homing beacon.







[redacted]

(b) Deck edge lights.

(c) Lineup lights.

(d) Touchdown lights.

(e) Overhead flood lights.

(f) Deck edge flood lights.

(g) Signal wands.

(h) Flags.

(i) Landing Signal Enlisted (LSE) suit.

(2) With the possible exception of special devices or additional personnel found beneficial to handling AV-8A terminal maneuvers, current systems should be adequate for the new tactical VTOL aircraft.

(3) Criteria have been established for a landing signal position 60 feet ahead and 30 degrees off the approach heading. The criteria does not specify a hover altitude. There is a position on the LPD-1 class deck forward of the landing area along the port side that should remain within pilot visibility for landing signals (wands). This condition presumes a final approach along the marked approach line, approximately 225 degrees bearing relative to the ship's heading, no excess wind correction angles to port, fuselage attitudes not excessive over the hover attitude, and a maximum of 75 feet height-above-deck at 200-foot range from the aft landing spot. Transposition of the cockpit visibility data indicates this position to be valid for hover heights of 25 feet or less.

m. Terminal Control.

(1) The LPD-1 class has a defined Air Plan for aircraft control procedures. CNO documentation defines procedure to the point of sample control wording for use aboard nonaviation ships.

(2) Control is divided between HDC and Pri-Fly on the basis of aircraft distance from the ship and meteorological conditions prevailing. Pri-Fly retains control of the deck and is supported by personnel, including an LSE, assigned to the land/launch and aircraft movement detail.

[redacted]





[redacted]

n. Miscellaneous.

(1) No capability exists aboard LPD-1 (RALEIGH class) for maintenance of the pilot's personal or support equipment. For the Sea Platform concept, this may be of minor concern. The pilot will generally bring all such necessary gear upon his arrival and return it to the Sea Base upon his departure. Supply and maintenance of such gear for helicopters is not currently provided in LPD-1 class ships.

403. (C) LPD-4 (AUSTIN Class). The LPD-4 is an amphibious transport dock, typical of its class, whose primary mission is to transport and land troops and their essential equipment and supplies by means of embarked landing craft or amphibious vehicles augmented by helicopter lift. The characteristics of this class are essentially the same as those of the LPD-1 (RALEIGH) class with the primary difference being in overall size. Most of the discussion on the RALEIGH class applies as well to the AUSTIN class. The LPD-4 is considered using specific data from the LPD-13 (USS NASHVILLE). These data are typical of the LPD-4 class except where noted as being otherwise.

a. Maintenance Shop Space. An aviation shop and storeroom with 144 square feet of deck area is provided on the main deck. In addition, there are two designated aviation storerooms totaling 140 square feet deck area located on the second deck. Space in other shops (metal, 488 square feet; carpenter, 280 square feet; electrical, 260 square feet; electronic, 88 square feet; and battery, 188 square feet) may be made available if needed.

b. Hangar Dimensions and Facilities. All AUSTIN class LPD's are equipped with a telescoping hangar except the LPD-4, AUSTIN, which is programmed to be retrofitted with one. The hangar's extended and contracted dimensions (length by width by height) are 64 feet by 25 feet by 21 feet and 23 feet by 22 feet by 19 feet, respectively, with a door size of 20 feet high and 18 feet wide. The hangar is not large enough for the AV-8A; the hangar interferes with the forward helicopter landing spot when it is extended.

c. Flight Deck Dimensions and Obstructions. Flight deck dimensions are shown in Figure C-4-2. The ship's superstructure represents an obstruction but will serve as a visual reference during VTOL operations.

d. Billeting Spaces. The LPD-4 class ship has a similar berthing capacity to that of the LPD-1. Table C-4-1

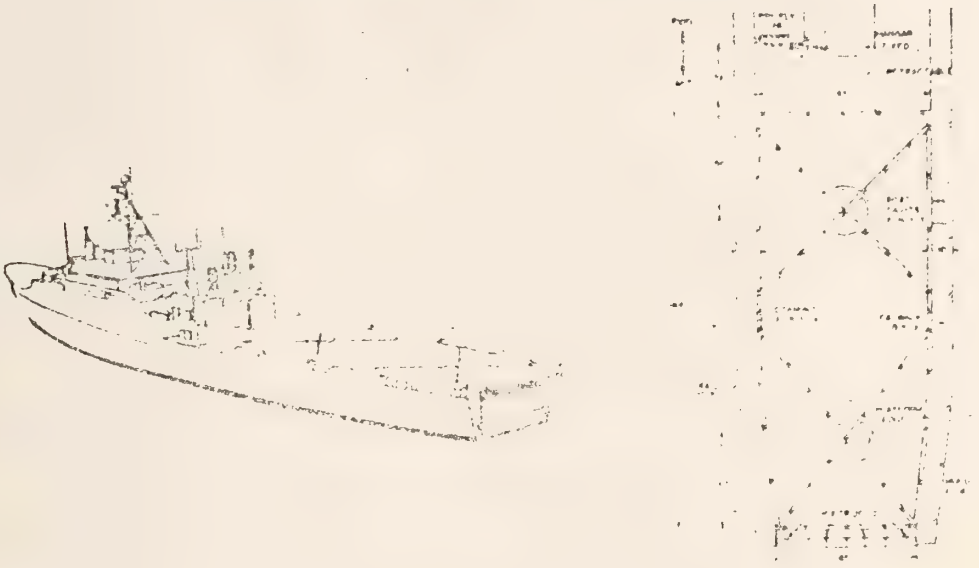
[redacted]





FIGURE C-4-2

(U) LPD-4 FLIGHT DECK DIMENSIONS

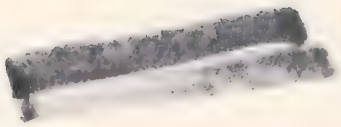


provides a breakdown in these accommodations. This ship would be expected to handle a similar four-sortie per day level and, as discussed under the LPD-1, should have little problem in accommodating, in a temporary basis, the 16 enlisted personnel required for a turnaround capability.

e. Administrative Spaces. A turnaround capability does not require administrative support.

f. Fueling. Adequate facilities for fueling the AV-8A are present on all LPD-4 class ships. Ships configured to carry aviation gasoline have a JP-5 capacity of about 210,000 gallons; those with no aviation gasoline have about 300,000 gallons of JP-5. Ready service tanks are about 17,000 gallons for both configurations. Single point pressure refueling is accomplished at 50 p.s.i. from either of two fueling stations at the flight deck edge.

g. Ordnance Storage and Handling. The discussion on ordnance storage and handling for the LPD-1 holds for the LPD-4 class with the following additional considerations:





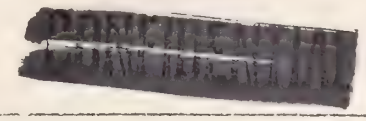


TABLE C-4-3. (U) ORDNANCE CARGO HOLDS SERVICED BY WEAPONS CARGO ELEVATORS ON LPD-4 CLASS SHIPS

HOLD LOCATION	FLOOR SPACE (SQ.FT.)	VOLUME (CU.FT.)	MINIMUM CLEARANCE	ELEVATOR OPENING
1st Platform Fwd	1,634	11,438	7'	7' x 8'
2d Platform Fwd	825	6,600	8'	7' x 8'
Special Weapons Magazine	603	4,474	7'5"	16' x 7'

(1) The LPD-4 class ship is larger in size, and this size difference shows up in the available cargo space. Those compartments satisfactory for the storage of air-launched ordnance are listed in Table C-4-3.

(2) The space required for the storage of air-launched ordnance would have less of an impact on the LFORM or "special" weapons storage area because of the larger size.

h. Aircraft Servicing Facilities. The LPD-4 class ships have servicing facilities similar to the LPD-1 class.

i. Communication Equipment.

(1) The LPD-4 (AUSTIN) class ships have UHF radio for air-to-ground communications. In addition, other communication facilities are listed in their aviation facilities as follows:

(a) VHF.

(b) HF.

(c) LF.

(d) FM.

(2) Internal communications aboard the ship relative to flight operations uses both visual and audio systems. These systems are applicable to all flight operations regardless of aircraft type and, therefore, should meet current operational standards. Some system deficiency exists in one or more facilities aboard some ships in the class.

(3) Two ships in the AUSTIN class LPD have obtained certification at the highest category, Level 1





[redacted]

Class 1, for medium and heavy helicopters. These are LPD-6 and LPD-7. These ships should have all necessary communications for any type of AV-8A operations contemplated. Systems configuration, performance, and redundancy have been demonstrated. Capability of other ships in the class may warrant examination prior to a planned deployment. Available data indicate that at least minimum systems are available.

j. Navigation Equipment.

(1) Navigation facility statements pertaining to the RALEIGH class also apply to the LPD-4 (AUSTIN class).

(2) All AUSTIN class LPD's for which data are available have not had the system certification flight check and function test required for facility certification. Thus, TACAN is operating under a waiver status, but it should be adequate for the day-VFR operations intended for AV-8A. Six ships in the AUSTIN class have no discrepancies in their aircraft navigation systems.

(3) Air search radar facilities described for LPD-1 class ships apply equally to LPD-4 (AUSTIN class).

(4) No inertial navigation alignment capability exists on LPD-4 class ships.

k. Crash Equipment. The LPD-4 (AUSTIN) class has equipments similar to those listed for the RALEIGH class LPD's.

l. Landing Aids. Statements pertaining to the landing aids aboard LPD-1 apply equally to LPD-4 (AUSTIN class). The discrepancies listed for those ships that have been denied certification indicate mostly minor lighting and/or deck marking deficiencies.

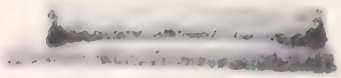
m. Terminal Control. Statements pertaining to terminal control aboard LPD-1 also pertain to LPD-4 (AUSTIN class).

n. Miscellaneous. Statements pertaining to maintenance of the pilot's personal and support equipment aboard LPD-1 also pertain to LPD-4 (AUSTIN class).

404. (C) LSD-36 (ANCHORAGE Class). The LSD is a dock landing ship. Its general mission is to transport and launch loaded amphibious craft and vehicles with their crews and embarked personnel in amphibious assault, and to render limited docking and repair service to small ships and craft and act as a control ship in an amphibious assault. No

[redacted]





helicopters are permanently assigned to LSD-36 class ships. The following considerations are pertinent to AV-8A operation:

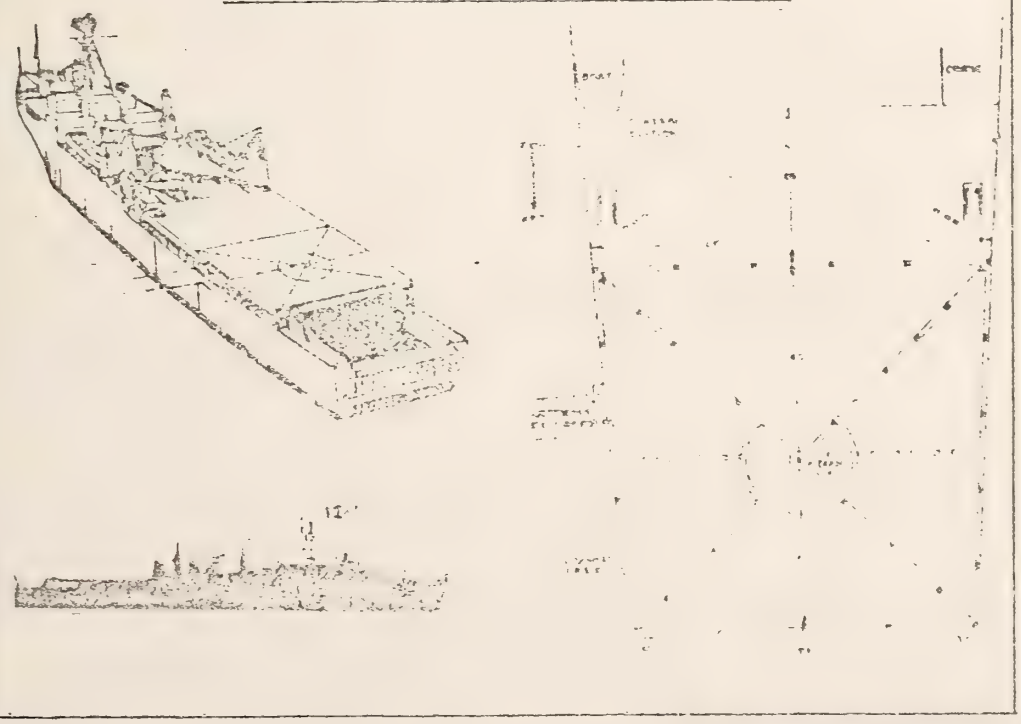
a. Maintenance Shop Space. There are no aviation shops or storerooms on board LSD-36 class ships. Space may be made available in shops on board (internal combustion engine , 504 square feet; metal, 550 square feet; carpenter, 575 square feet; electrical, 240 square feet; electronic, 92 square feet; and battery, 200 square feet).

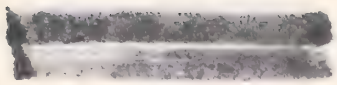
b. Hangar Dimensions and Facilities. There are no hangars on the LSD-36 class ships.

c. Flight Deck Dimensions and Obstructions. Flight deck dimensions are given in Figure C-4-3. The flight deck is unobstructed. The superstructure is well forward of the landing area. A 50-ton crane is located on the starboard side of the ship, 68 feet forward of the landing area.

FIGURE C-4-3

(U) LSD-36 FLIGHT DECK DIMENSIONS







[redacted]

TABLE C-4-4. (C) LSD-36 CLASS BERTHING SPACES

	OFFICERS	CPO'S & MSGT'S	ENLISTED
Ship's Company	35	23	410
Troops	26	17	292
Maximum Berthing Capacity	61	40	702

(2) The LSD will not be capable of providing AV-8A turnaround service due to a lack of air-launched ordnance storage space. Its service then will be limited to support on a standby basis as a staging site. The two or three personnel required to provide this service for four sorties per day should not significantly affect the berthing capacity of the LSD.

e. Administrative Spaces. There is no administrative support required for the projected level of AV-8A operations.

f. Fuel Handling. Adequate facilities for fueling the AV-8A are available on the LSD-36 class ships. There are about 32,000 gallons of JP-5 on board, 1,500 gallons of which are in ready-service tanks. Single point pressure refueling is provided at 50 p.s.i.

g. Ordnance Storage and Handling. No capability for ordnance storage exists on the LSD.

h. Aircraft Servicing Facilities. The LSD-36 meets all of the necessary servicing provisions set forth in paragraph 402h, except for 400-Hertz, 115/208-volt, three-phase, Y-type power.

i. Communications.

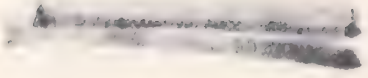
(1) The LSD-36 class ships have very limited aviation facilities, and without considerable addition to present systems, the use of this class ship as a Sea Platform for AV-8A must also be limited.

(2) The following listed communication equipments are designated in the aviation facilities:

(a) UHF.

(b) VHF. [redacted]





(c) HF.

(d) LF.

(e) FM.

(3) No data have been obtained as to the frequency capability of any of these equipments, and no conclusion should be drawn concerning system configuration to provide communications at specific ship's stations.

j. Navigation. The navigation equipment listed for the LSD-36 is solely UHF homer. TACAN is not installed. As explained previously, UHF homer facilities are not certifiable facilities. The equipment should be of assistance under VFR conditions, but some restrictions may be imposed for instrument penetrations to below VFR conditions.

k. Crash Equipment.

(1) The following crash and safety equipment is listed for LSD-36:

(a) Salt water.

(b) Fog-foam.

(c) CO_2 bottles.

(d) PKP bottles.

(e) All-purpose nozzles (APN).

(f) Applicator.

(g) Two hot suits.

(h) Safety nets.

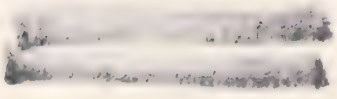
(i) Air/sea rescue kit.

(2) The specification of equipment above was generated from a survey of ship's data plus information submitted from the ship.

l. Landing Aids.

(1) The landing aids listed for the LSD-36 are the following:





[redacted]

(a) Signal wands.

(b) Flags.

(c) Wind sock.

(d) LSE suit.

(2) Deck markings with touchdown circle, approach lines, and edge profile are shown in the facilities sketch. Lights are indicated within the deck markings. Homing beacon and flood lighting of the flight deck are also listed in the facilities tabulation.

(3) Inspection data were available for LSD-37 (USS PORTLAND) revealing helicopter landing aids deficiencies, probably minor for the AV-8A operation intended from these platforms. More serious may be landing aid needs or ship modifications required due to flight path obstructions found upon inspection. Data are not available to determine if the obstructions are typical of the class or related to an individual ship.

m. Terminal Control. Control of the AV-8A during approach and landing will be some type of shared function (due to communication network on ship) between the bridge, CIC, fly-control station, and the LSE. The procedure may differ from that aboard ships with certifiable communication installations.

n. Miscellaneous. No capability exists aboard LSD-36 class ships for maintenance or supply of the pilot's personal equipment.

405. (C) LCC, AOE, AOR, and AE. The LCC-19 (BLUE RIDGE class), AOE-1 (SACRAMENTO class), AOR-1 (WICHITA class), AE-21, AE-23, and AE-26 class ammunition ships are addressed in detail in the Ship Compatibility Study by the Naval Ship Research and Development Center. Certification of these ships for AV-8A operation is unlikely; therefore, for purposes of this concept, the characteristics of these ships will only be summarized.

a. Maintenance Shop Space. The LCC-19, AE-21, and AE-23 class ships are not equipped with aviation repair shops. The AOE-1, AOR-1, and AE-26 class ships do have sufficient facilities to provide aviation repair shops of minimal size.

b. Hangar Dimensions and Facilities. All of the above ships either have no hangars or those available (AOE) cannot accommodate the AV-8A.

[redacted]





c. Flight Deck Dimensions. All of the above ships' flight deck dimensions are listed in Table C-2-1.

d. Billeting Spaces. All of the above ships can provide sufficient berths, as required, for mission turnaround checks of the AV-8A.

e. Administrative Spaces. No administrative spaces are required for a turnaround capability.

f. Fuel Storage and Handling. All of the above ships have fuel storage and handling facilities compatible with the AV-8A.

g. Ordnance Storage and Handling. All of the above ships, except the LCC-19, have some capability for aviation ordnance storage and handling (providing the appropriate equipment is supplied).

h. Aircraft Servicing Facilities. The aircraft servicing facilities are minimal, although many of the more critical items, listed in paragraph 402h, can be provided.

i. Communication Equipment. All of the above ships have UHF, VHF, and HF equipment.

j. Navigation Equipment. The LCC-19 and the AOE-1 class ships have TACAN. The AOR-1 and the AE class ships have no aircraft navigation equipment compatible to the AV-8A.

k. Crash Equipment. All of the above ships have at least minimal crash equipment available.

l. Landing Aids. All of the above ships have visual landing aids.

m. Terminal Control. All of the above ships have the capability to provide terminal control communications.

n. Miscellaneous. None of the above ships have the capability for maintenance of the pilot's personal flight equipment.





[redacted]

SECTION 5. SEA BASE OPERATIONS (U)

501. (C) General.

a. This section presents an analysis of the impact of AV-8A operations on helicopter off-loading capabilities during amphibious operations from LPH and LHA type ships. The air-launched ordnance assembly and flow on these ships is also discussed.

b. Previous discussion in Sections 2, 3, and 4 of this annex has established which ship types and classes are potential Sea Bases and Platforms. The type and combinations of these ships that can be utilized for AV-8A employment during an amphibious operation can vary significantly, reflecting variances in missions, task organizations, and shipping availability. Table C-5-1 illustrates some of the varied combinations of ships possible in representative amphibious assault forces. Additionally, CVA and CVS type ships would be available in carrier forces supporting large amphibious assaults. The LPH and LHA were selected for this analysis because AV-8A employment on these ships would directly impact on helicopter operations during an amphibious assault.

c. An MAU/BLT lift from these ships was selected as representative of intense helicopter activity during a single MAU operation or a slice of a larger MAB or MAB assault. Table C-5-2 shows the personnel strengths and a breakdown of the initial assault and follow-on elements of a representative BLT. Table C-5-3 provides the load requirements to lift the initial assault elements and its support equipment.

502. (U) MAU Operation From an LPH. The concept of an MAU operation involves the use of one LPH or LHA as indicated in Table C-5-1. The LPH, being the smaller of the two ships, represents a more difficult operational problem in incorporating the AV-8A into its normal mode of operations. As a basis for comparison, the sequence and timing involved in landing a BLT without AV-8A support will first be established. The following assumptions will prevail:

a. The helicopter complement will consist of CH-46 types only.

b. The task force will stand off 20 miles from the shore.

c. No attrition of helicopters.

[redacted]

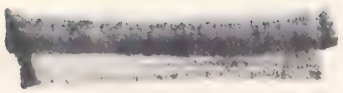




TABLE C-5-1. (U) REPRESENTATIVE AMPHIBIOUS ASSAULT FORCE (ALL 20-KNOT SHIPPING)[1]

FORCE		TROOPS	LHA LPH[2]	LPD	LSD	LST	LKA	LPA	LCC	LPSS	TOTAL
ATF/MAF[3] [4]		32,867	10	7-8	6-7	13-15	2-3	1	2	1	42-47
ATG/MAB[5]	Upper	14,300	4	4	5	9	1	0	1	1	25
	Rep	11,440	3	3	3	7	1	0	1	1	19
	Lower	8,580	2	2	2	5	0	0	1	1	13
ATU/MAU[5]	Upper	4,525	1	2	1	4	0	0	0	0	8
	Rep	3,620	1	1	1	3	0	0	0	0	6
	Lower	2,715	1	0	1	2	0	0	0	0	4

1 This representative force structure is currently undergoing study and revision.
2 The mix of other ship types will vary as the LHA to LPH ratio changes.
3 Amphibious ships lift the MAF assault echelon. The follow-or echelon will be lifted in Military Sea Transportation Service (MSTS) ships. The follow-on echelon will require about 35 MSTS ships, arriving in the objective area by D-day + 5 (D+5).
4 Without SATS.
5 The lift requirements for MAU and MAB are representative and may vary as much as +25 percent depending on the mission assigned. Accordingly, the number of ships that make up ATG's and ATU's may vary from about 13 to 25 and four to eight, respectively.



[redacted]

TABLE C-5-2. (C) PERSONNEL STRENGTHS OF THE BATTALION LANDING TEAM

UNIT	TOTAL STRENGTH	INITIAL ASSAULT	FOLLOW-ON
Infantry Battalion	48-1177	42-1046	6-131
105 Howitzer Battery (Reinf)	11-139	11-127*	0-12
Engineer Platoon (Reinf)	1-49	0-33	1-16
Shore Party Platoon (Reinf)	1-49	1-16	0-33
Landing Zone Control Team	0-4	0-4	--
TOTAL	61-1418	54-1226	7-192

* The Artillery Battery would not be lifted at the same time as the initial assault but would be on call with transports standing by. Personnel comprising the Artillery Battery are included in the initial assault as follows:

Infantry Companies	5-22
Recon Party	3-17
Command Group	1-6
TOTAL	9-45

Personnel requiring to be lifted as on call are 2-82.

[redacted]





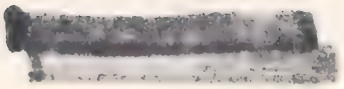
[redacted]

TABLE C-5-3. (C) SPACE REQUIREMENTS TO LIFT THE INITIAL ASSAULT ELEMENTS

ITEM	SPACE* PER	NUMBER	SPACES	WEIGHT
Radio Set AN/MRC-83	13.5	2	27.0	6,480
Radio Set AN/MRC-87	15.0	1	15.0	3,600
Radio Set AN/MRC-109	11.0	6	66.0	15,840
Trailer 1/4 Ton M416	4.5	2	9.0	2,160
Truck Platform 1/2 Ton M274	7.5	21	157.5	37,800
Truck Utility 1/4 Ton M151	10.5	2	21.0	5,040
Class V (Pallets)	6.0	19	114.0	17,360
Personnel	1.0	1196	1196.0	287,040
Total Personnel, Equipment & Supplies			1605.5	385,320
ON CALL REQUIREMENTS				
Trailer 1/4 Ton M416	4.5	7	31.5	7,560
Truck 1/4 Ton M151	10.5	7	73.5	17,640
Howitzer Light	15.5	6	93.0	22,320
Class V (Pallets)	9.0	23	107.0	49,680
Personnel	1.0	84	84.0	20,160
Total (On Call)			489.0	117,360
GRAND TOTAL			1094.5	502,680

* A space is considered to be 240 pounds.

[redacted]



[redacted]

TABLE C-5-4. (U) CH-46 MISSION DATA
(SHIP-TO-SHORE, SEA LEVEL, 90°F, 20-NAUTICAL MILE RADIUS)

Average Speed (Knots)	130
Time of Flight (Minutes) (40 Nautical Miles)	16
Loading and Refueling Time (Minutes)	5
Unloading Time (Minutes)	2
Cycle Time (Minutes)	23
Troops Only*	20
Tactical Payload (Pounds)**	4,911

* Combat equipped at 240 pounds per man.
** Tactical payload reflects loss of potential payload due to cabin constraints and combat loading considerations.

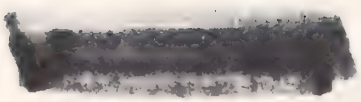
d. No bottlenecks are encountered at the landing zone which cause delays beyond specified times given for unloading purposes.

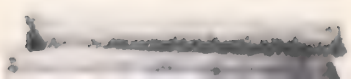
e. The helicopter mission data are as given in Table C-5-4.

f. The initial assault elements and equipment are landed without interruption with the on call items immediately following.

503. (U) Base Case Analysis. (Much of the data and some of the procedure being followed here are taken from reference 19.) As seen from Tables C-5-2 and C-5-3, the landing of the initial assault elements and on call requirements of the BLT involve the movement of 1,280 personnel and 502,680 pounds of equipment. Tables C-5-5 and C-5-6 show the CH-46 sorties required to lift these elements to the assault area. A total of 99 CH-46 sorties is required to compete the assault movement. Using the total complement of 27 CH-46 helicopters and seven loading spots on the LPH flight deck provides for three flights of seven helicopters and one flight of six in every four waves. This operation proceeds with 14 helicopters on the flight deck (seven on the landing spots and seven on deck edge awaiting movement to the spots after the departure of the first wave) and 13 helicopters orbiting the ship. A wave of helicopters is assumed to land immediately after the departure of the preceding wave (unless all helicopters are in transit and the follow-on wave is not

[redacted]





[redacted]

TABLE C-5-5. (C) CH-46 SORTIES TO LIFT BLT
INITIAL ASSAULT ELEMENTS

ITEM	UNIT WEIGHT (POUNDS)	PAYLOAD PER HELO (POUNDS)	SORTIES
Radio Set AN/MRC-83	3,240	4,680	2[1]
Radio Set AN/MRC-87	3,600	4,680	1[2]
Radio Set AN/MRC-109	2,640	4,440	6[3]
Trailer 1/4 Ton M416	1,080	4,680	1[3]
Truck Platform 1/2 Ton M274	1,800	4,680	10[4]
Truck Utility 1/4 Ton M151	2,520	4,320	2[3]
Class V (Pallets)	1,440	3,240	1[3]
Personnel	240	4,800	50
TOTAL			73

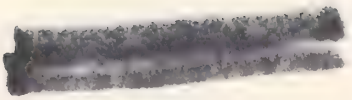
1 Includes one Class V pallet per sortie.
2 Includes 1/4 Ton M416 trailer.
3 Includes 1/2 Ton truck platform per sortie.
4 Includes two Class V pallets/sortie save two flights of two truck platforms/sortie at 3,600 pounds/sortie.

TABLE C-5-6. (C) CH-46 SORTIES TO LIFT BLT
ON CALL ITEMS

ITEM	UNIT WEIGHT (POUNDS)	PAYLOAD PER HELO (POUNDS)	SORTIES
Howitzer Light	3,720	4,800	6[1]
Trailer 1/4 Ton M416	1,080	3,600	1[2]
Truck 1/4 Ton M151	2,520	4,680	6[3]
Class V (Pallets)	2,160	4,320	8
Personnel	240	4,800	5[4]
TOTAL			26

1 Includes one 1/4 ton trailer per sortie.
2 Includes one 1/4 ton truck.
3 Includes one Class V pallet per sortie.
4 Includes one sortie with four personnel and one Class V pallet at a payload of 3,120 pounds.

[redacted]





available). Figure C-5-1 shows the sequence and time required to land the initial assault element and the on call items. The 99 CH-46 sorties are found to require 79 minutes to depart from the ship.

504. (U) LPH-MAU Operation Including AV-8A. The LPH, as discussed in Section 3, is capable of supporting 18 CH-46 helicopters and 6 AV-8A's. The assault operation to be considered while using the AV-8A will again assume no attrition of aircraft from either combat or maintenance problems. The entire complement of helicopters will be used in the ship-to-shore movement with flights of AV-8A's, two per flight, being interspersed to provide close-air support at specific times and on an on call basis. The concept of operation will consider utilizing the AV-8A under extensive STO operations and exclusive VTOL operations.

a. Extensive STO During Initial Assault. Maximum use of the LPH flight deck is desired so as to increase payload. A second possible benefit in STO operation being the increased engine life that can be expected from this mode.

(1) In this operation, it is attempted to provide AV-8A close-air support, in flights of two, for each of the first two helicopter waves. The third flight is maintained on call aboard the LPH. The helicopter waves are flown with six CH-46's per wave. One LPD and one LSD are present in the assault force (see Table C-5-1, a representative MAU). The LPD provides a turnaround service, including rearming, for two AV-8A's at a time, while the LSD serves as a staging site providing fuel and demineralized water only. Figure C-5-2 shows the sequence and intermeshing of the CH-46 waves and the AV-8A flights. This operation is conducted with the LPH standing off 20 miles from the shore and requires the services of the accompanying LPD and LSD to avoid traffic jams on the LPH deck. The assault procedure deviates only slightly from normal operations with the main difference being in the initial maneuver which requires the orbiting of 12 helicopters about the LPH so as to allow a wave of six helicopters and a flight of two AV-8A's to launch to the beach. The reason for this procedure is to provide for a minimum time delay between the first and second waves arriving in the assault area and to allow a clear deck for AV-8A STO operations after each of the first two helicopter waves. The overall operation provides for optimum utility of the AV-8A by providing close-air support during the arrival of the initial waves in the landing area. The overall time for an AV-8A attack mission of 20-nautical miles radius is, from Annex B, 16 minutes. (The extra deck run available on the LPH will provide for increased payload, and it is

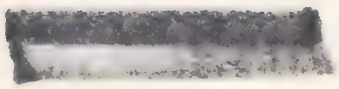
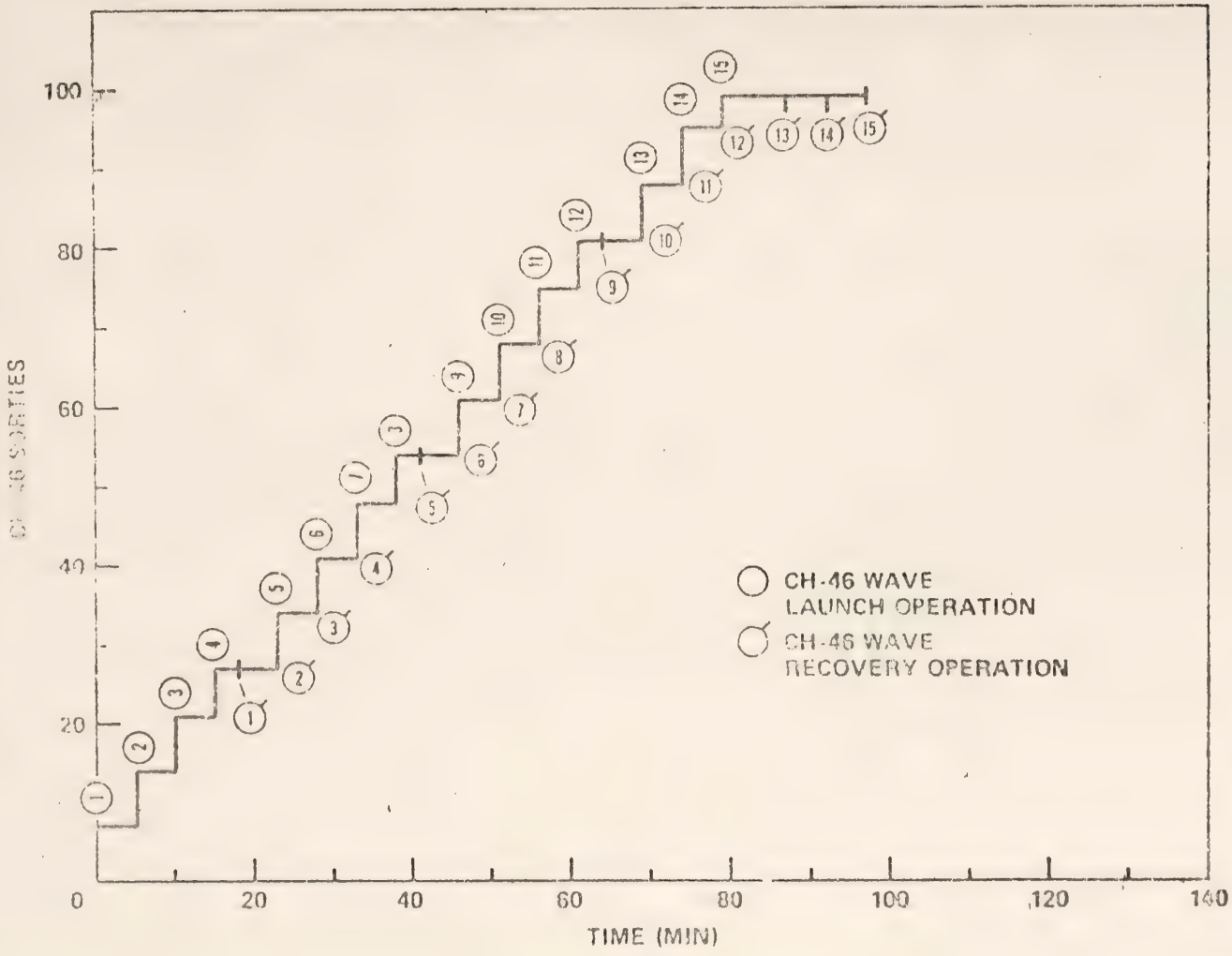




FIGURE C-5-1

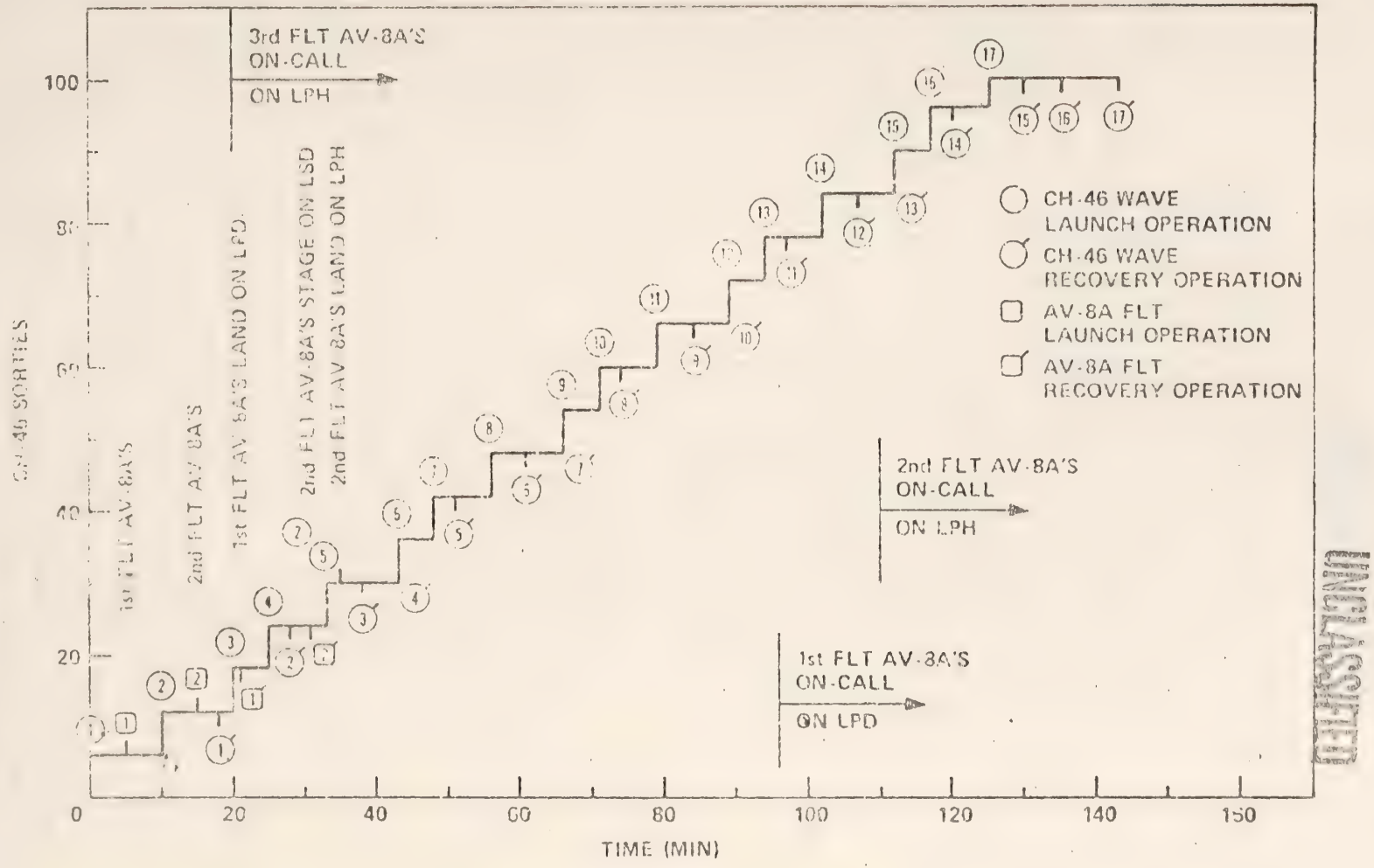
(U) SEQUENCE OF CH-46 WAVES TO LAND BLT AND SUPPORT EQUIPMENT (BASE CASE)



UNCLASSIFIED
UNCLASSIFIED

FIGURE C-5-2

(U) SEQUENCE OF CH-46 WAVES AND STO AV-8A FLIGHTS DURING AN ASSAULT FROM AN LPH WITH AN LPD AND AN LSD IN SUPPORT



CONFIDENTIAL

likely that some of this payload will be absorbed in providing enough fuel for extra loiter time in the assault area. However, for planning purposes, the mission time will be 16 minutes as provided in Annex B.) The first flight of AV-8's, after providing cover for the first helicopter wave, returns to the task force and lands (VL), 16 minutes after it left the LPH, on the LPD where it is provided with turn-around service. The 1 hour 15 minutes required for turn-around finds this AV-8A flight ready for on call service just after the 13th helicopter wave departs the LPH. The 16-minute flight time for this mission finds the second flight of AV-8's returning to a busy LPH deck. This flight then lands on the LSD, takes on fuel, and returns to the LPH after the departure of the fifth helicopter wave. These aircraft are taken below and refurbished, being ready for on call service just after the departure of the 14th helicopter wave. The third flight of AV-8's could be called at any time between the third and 12th helicopter wave. These AV-8's could depart the LPH, in the STO mode, between helicopter waves, causing a delay of 5 minutes in the landing sequence. This flight would return to the LPH directly or stage from the LSD depending on flight deck activity when it returns. The entire assault operation is found to take 2 hours 5 minutes, approximately three-quarters of an hour longer than in the base case of 27 helicopters and no AV-8A's.

(2) In order to provide some demonstration of feasibility for the suggested operation procedures, scale models of the CH-46, the AV-8A, and the various ship decks involved were used to stage the more critical features of the operation. The following discussion and figures illustrate the sequence of events. Figure C-5-3 illustrates the positions of the first flight of AV-8A's and the first wave of helicopters just prior to the departure of the first wave. Figure C-5-4 shows the second and the third AV-8A flights being made ready on the hangar deck. In this figure, the second flight is undergoing INAS alignment, while the third flight is being armed. Figure C-5-5 shows the take-off roll of the first of the two AV-8A's in the first flight. The overlay in this figure shows the jet exhaust of the rolling aircraft and indicates the second AV-8A of this flight is positioned so as to avoid the jet blast and any debris that may be kicked up. The first aircraft of the second flight is shown on the elevator, on its way to the flight deck, as the first flight departs. This sequence is repeated for the second helicopter wave. Figure C-5-6 shows the first flight coming aboard the LPD with one aircraft landed and moved forward while the other is just touching down. Figure C-5-7 shows a similar procedure on the LSD flight deck as the second flight comes aboard and prepares for staging



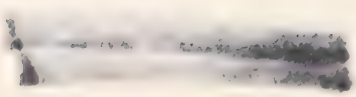


FIGURE C-5-3

(C) AV-8A FLIGHT AND WAVE OF CH-46 HELICOPTERS ON LPH FLIGHT DECK

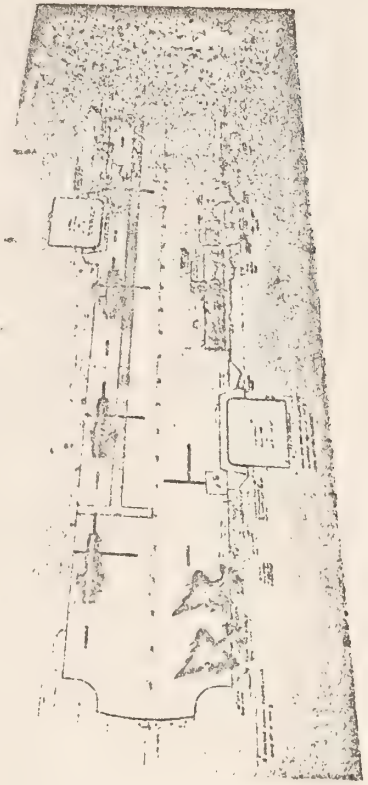


FIGURE C-5-4

(C) AV-8A FLIGHTS 2 AND 3 BEING PREPARED ON LPH HANGAR DECK





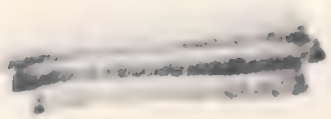


FIGURE C-5-5

(C) AV-8A ON STO TAKE-OFF ROLL ON LPH

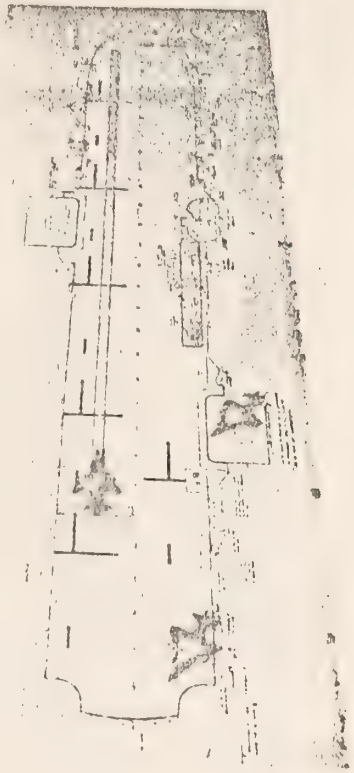
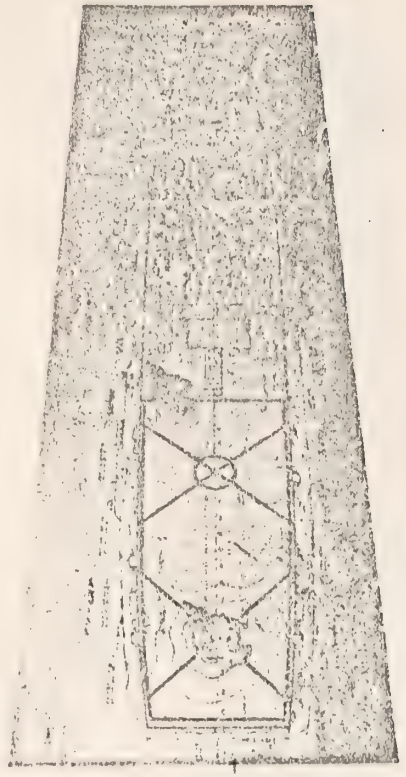


FIGURE C-5-6

(U) AV-8A VL ON LPD (EXHAUST VELOCITY PROFILE SHOWN)



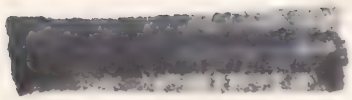




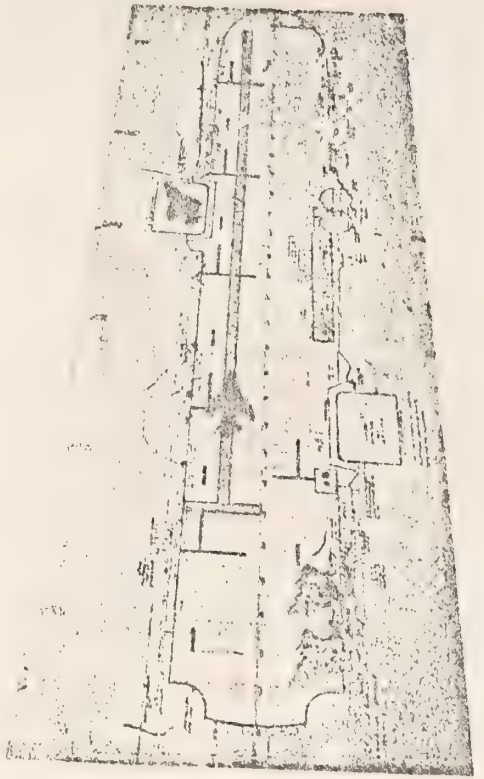
FIGURE C-5-7

(U) AV-8A VL ON LSD FLIGHT DECK SHOWING EXHAUST VELOCITY PROFILES



FIGURE C-5-8

(C) AV-8A VL ON LPH FLIGHT DECK







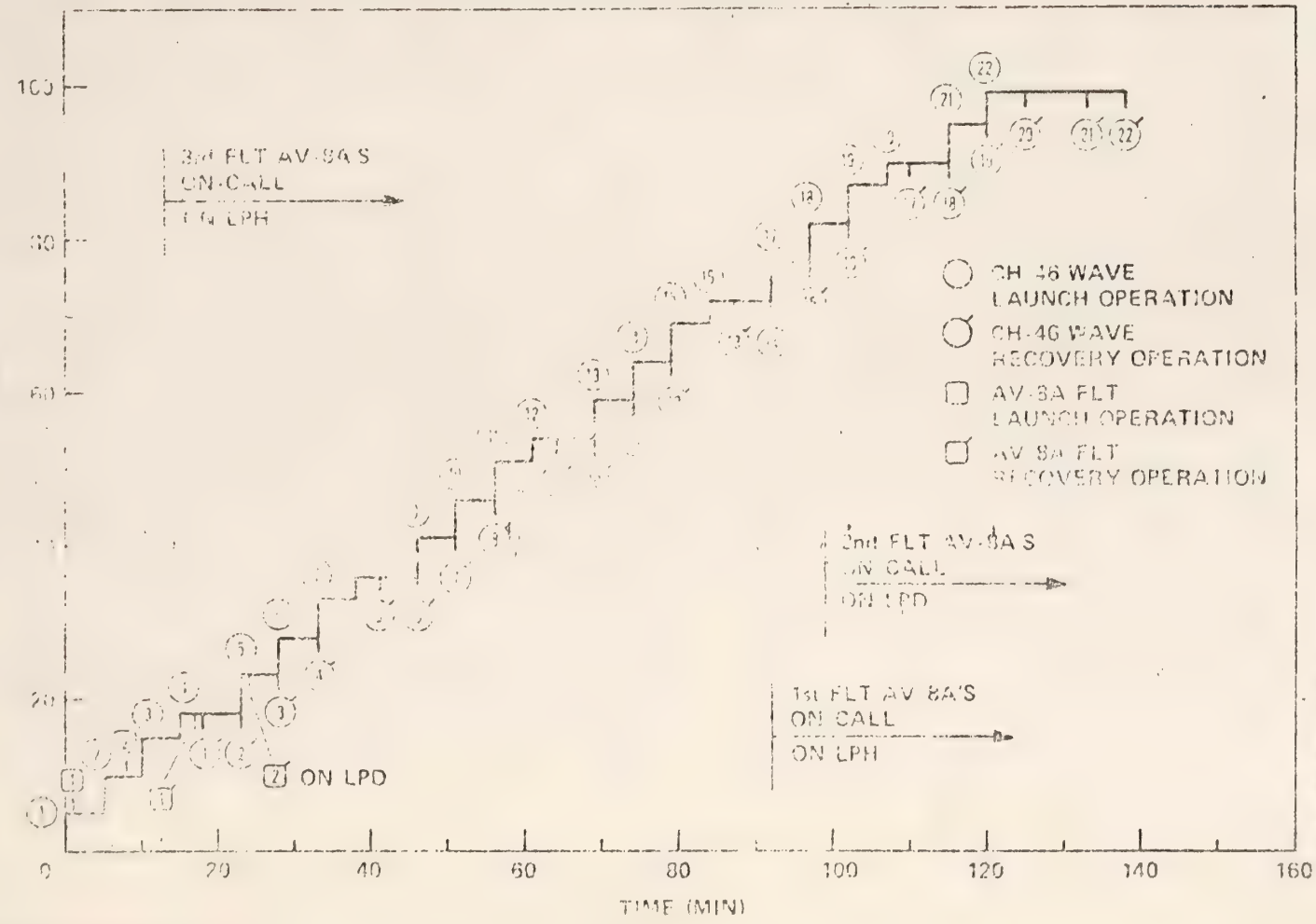
to the LPH. Figure C-5-8 shows the position of the on call third flight while the second flight is coming aboard (VL) the LPH after staging from the LSD. The first aircraft is shown being taken below on the forward elevator while the second is setting down. The overlay in this figure shows the velocity profile of the impinging exhaust. (The outermost marking in this profile represents a velocity of 25 feet per second.) Figure C-5-3 is now indicative of the third flight of AV-8A's maintaining an on call status while the assault movement continues. Further flights would simply repeat this procedure with the exception of the second flight which is now aboard the LPD. The second flight would continue to operate from the LPD until completion of the troop movement ashore. (A secondary mission of the LPH, that of serving as a hospital ship, implies the possibility of a continually busy deck and may require continued use of the LPD and LSD beyond completion of the initial assult movement.)

b. Exclusive VTOL During Initial Assault. In this mode of operation, the aft portion of the LPH flight deck is used exclusively for AV-8A operation with the helicopters being restricted to the forward five landing spots.

(1) As with STO operations, the first two helicopter waves will be provided with AV-8A close-air support. The third flight is maintained on call aboard the LPH. Using the total complement of 18 CH-46 helicopters and five loading spots on the LPH flight deck provides for three flights of five helicopters and one flight of three in every four waves. One LPD and one LSD are in support with the LPD providing turnaround service and the LSD serving as a staging platform only. AV-8A VTOL operations do not slow down the cycling of helicopter waves. Helicopter waves depart at 5-minute intervals with an 8-minute interval after every fourth wave; the 8-minute intervals being the result of the CH-46 cycle time between the ship and the assault area. Figure C-5-9 shows the sequence and timing of the helicopter waves and AV-8A flights during the initial assault movement. The ship-to-shore movement begins with five helicopters on the landing spots and 13 helicopters orbiting the ship. The initial wave departs for the assault area while the second wave comes aboard for loading. A flight of two AV-8A's follows the initial wave but arrives in the assault area first and provides CAS for this wave during the landing. This procedure is repeated for the second wave. The first flight of AV-8A's returns to the task force and lands (VL) on the LPH. The deck would be clear of helicopters at this time, since the fourth wave has departed and the first wave has yet to return from the beach. This flight would be struck below and made ready for further service, being ready for on call status

FIGURE C-5-9

(U) SEQUENCE OF CH-46 WAVES AND VTO AV-8A FLIGHTS DURING AN ASSAULT FROM AN LPH WITH AN LPD AND AN LSD IN SUPPORT



UNCLASSIFIED

[redacted]

1 hour 15 minutes later or just after the departure of the 15th wave. The second flight of AV-8A's, after providing cover for the second helicopter wave, returns to the task force and lands on the LPD. This flight is provided with turnaround service and is ready for further deployment shortly after the departure of the 16th wave. The third flight of AV-8A's could be called at any time after the third wave. The return to the ship of this flight would vary depending on the phase of the operation. If its return comes beyond the 92-minute mark in the operation, it will find two AV-8A's on the LPH fantail. It may be required then to stage the third flight from the LSD, bringing it aboard the LPH during that period after every fourth wave when the forward part of the flight deck is open. An alternate procedure would be to land the third flight aboard the LPD and provide it with turnaround service from that ship. The alternate procedure would be less desirable since this would preclude any further use of the LPD for that day as its expected support level of four sorties per day would now be saturated. In either case, this flight would not cause a further delay in the troop ship-to-shore movement. The entire assault operation is found to take 2 hours. This is 41 minutes longer than the base case and 5 minutes less than the STO supported operation.

(2) The sequence of events in this operation, as with the STO mode, was followed with the related scale models Figure C-5-10 shows the LPH flight deck just prior to the departure of the initial assault wave. As depicted, the helicopters are to operate from the forward five landing spots with the fantail being reserved for AV-8A VTOL operations. Flight #2 is undergoing INAS alignment, while flight #3 is being loaded with ordnance. Figure C-5-11 shows the first aircraft of flight #1 leaving the deck VTO with the second aircraft of this flight far enough removed so as to avoid its exhaust blast. In this figure, the first aircraft of the second flight is shown on the elevator being brought to the flight deck. This sequence is repeated for the second helicopter wave and second AV-8A flight. Figure C-5-8 shows flight #1 landing on the LPH while flight #3 awaits call. Figure C-5-6 shows flight #2 landing on the LPD flight deck. Figure C-5-12 shows flight #3 landing on the LPD (if this option is exercised) with flight #2 forward. If flight #3 should elect to stage on the LSD and come aboard the LPH when the opportunity presents itself, then Figures C-5-7 and C-5-8 serve to illustrate these movements. Operations beyond the 96-minute mark, that is when flight #1 is again ready for service and flight #3 is back aboard the LPH, would be similar to those discussed to this point. Flight #2, however, would continue to operate from the LPD for the duration of the initial assault movement.

[redacted]



FIGURE C-5-10

(C) LPH FLIGHT DECK SHOWING INITIAL HELICOPTER WAVE AND AV-8A FLIGHT STAGED FOR VTO OPERATIONS



FIGURE C-5-11

(C) AV-8A FLIGHT DEPARTS LPH IN VTO MODE WHILE HELICOPTER WAVE IS LOADED

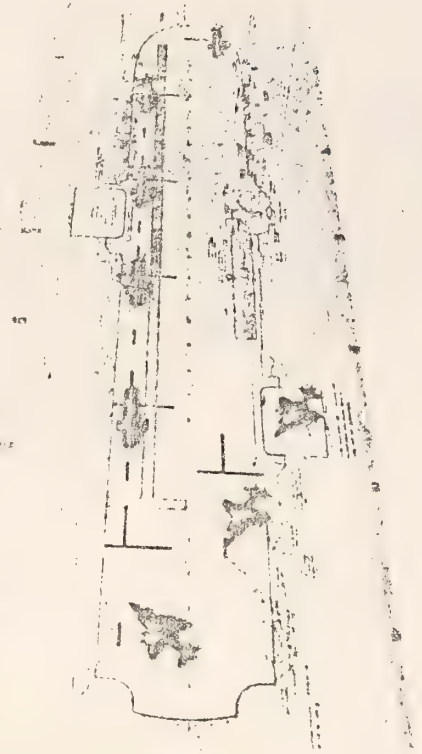
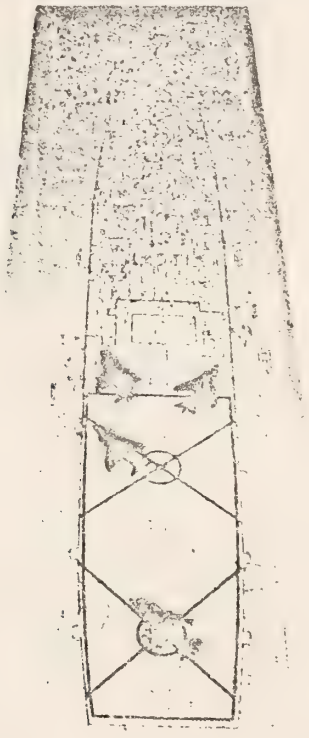




FIGURE C-5-12

(U) AV-8A FLIGHT LANDS ON LPD WHILE EARLIER FLIGHT IS BEING SERVICED



c. Sustained Operations From the LPH. On completion of the initial assault movement, the AV-8A is presented with a different set of circumstances in attempting to sustain support for the troops ashore. The 18 helicopters used in the assault may not be fully utilized during this period, and parking space must be provided on the LPH for some of these. This may inhibit AV-8A operations somewhat. A number of helicopters may be assigned to off-load supplies and equipment from other ships in the force and some would be occupied in continued ship-to-shore movement from the LPH, possibly returning battle casualties from the assault area. It is unlikely that a clear flight deck could be planned on for other than brief and sporadic intervals. If two or three helicopters are deployed to other ships and another three to four continue to operate from the LPH, then a feasible mode of operations would see some helicopters stored on the hangar deck, the forward four landing spots being reserved for CH-46 use exclusively, and AV-8A limited to VTOL operations from

the aft portion of the deck. All turn-around service for the four AV-8A's still aboard the LPH would be provided for on the flight deck. Figure C-5-13 illustrates the LPH flight deck in this mode of operations. All four aircraft are shown aboard. A bomb farm (BF) is shown on the starboard side, aft of the elevator, as rearming, as well as other services, would be provided on the flight deck. Figure C-5-14 shows the LPD with two AV-8A's being serviced, since these aircraft continue to operate from this ship, while two CH-46 helicopters are being loaded with supplies. The concept of sustained operations after the landing of the initial assault elements appears feasible with the AV-8A restricted to VTOL. STO operations would be more desirable, but a clear deck could not be planned on, and since bomb loads must be based on the method of operation, dependable planning suggests the desirability of VTOL operations.

505. (U) Air-Launched Ordnance Stowage and Handling on the LPH. Paragraph 304 provided information on LPH ordnance mix, stowage, handling equipment, and general flow. This section presents analysis of ordnance stowage, handling, and flow aboard LPH. The CVA and CVS ordnance support capability has been estalished for other type aircraft, and AV-8A imposes no new requirement in this regard. Since AV-8A will generally be flown to Sea Platforms in a mission-ready configuration, no ordnance support is required. However, the LPD ordnance support capability described in Section 4 may serve to increase the AV-8A's employment flexibility when the LPD class ship is used as an AV-8A Sea Platform.

a. Ordnance Stowage. Annex G provides rationale for the mix of AV-8A weapons considered most desirable for sea basing from a probability of kill (PK) standpoint. The constraints of storage compatibility and simplicity of handling were also considered.

(1) The amount of required stowage is dictated by the criteria established for a typical mission of 50 nautical mile radius, 300 feet deck roll, no wind, and the desirability of loaded guns on every mission. These criteria result in eight stores (MK-82/Rockeye II) per sortie.

(2) Based on the desired ordnance mix, payload, and four sorties per day, each AV-8A requires approximately 1,120 cubic feet of ordnance stowage space per day. Figure C-5-15 indicates the required space (includes stowage factor) for two to 10 AV-8A's operating from 1 to 8 days.

(3) The areas suitable for stowage of air-launched ordnance are discussed in paragraph 304. The availability of

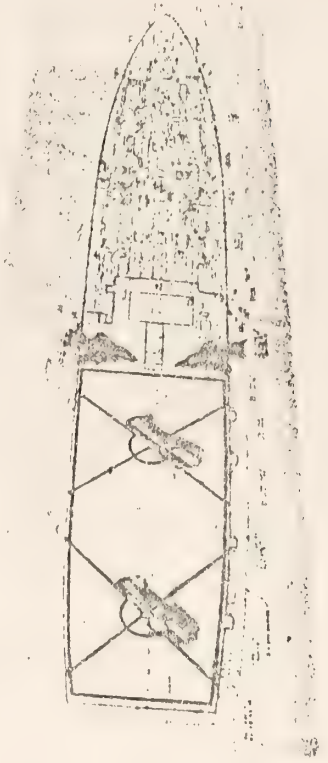
FIGURE C-5-13

(C) LPH FLIGHT DECK DURING SUSTAINED OPERATIONS FOLLOWING INITIAL ASSAULT MOVEMENT



FIGURE C-5-14

(U) HELICOPTER OPERATIONS ON LPD FLIGHT DECK WHILE AV-8A FLIGHT IS BEING SERVICED



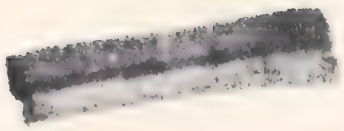
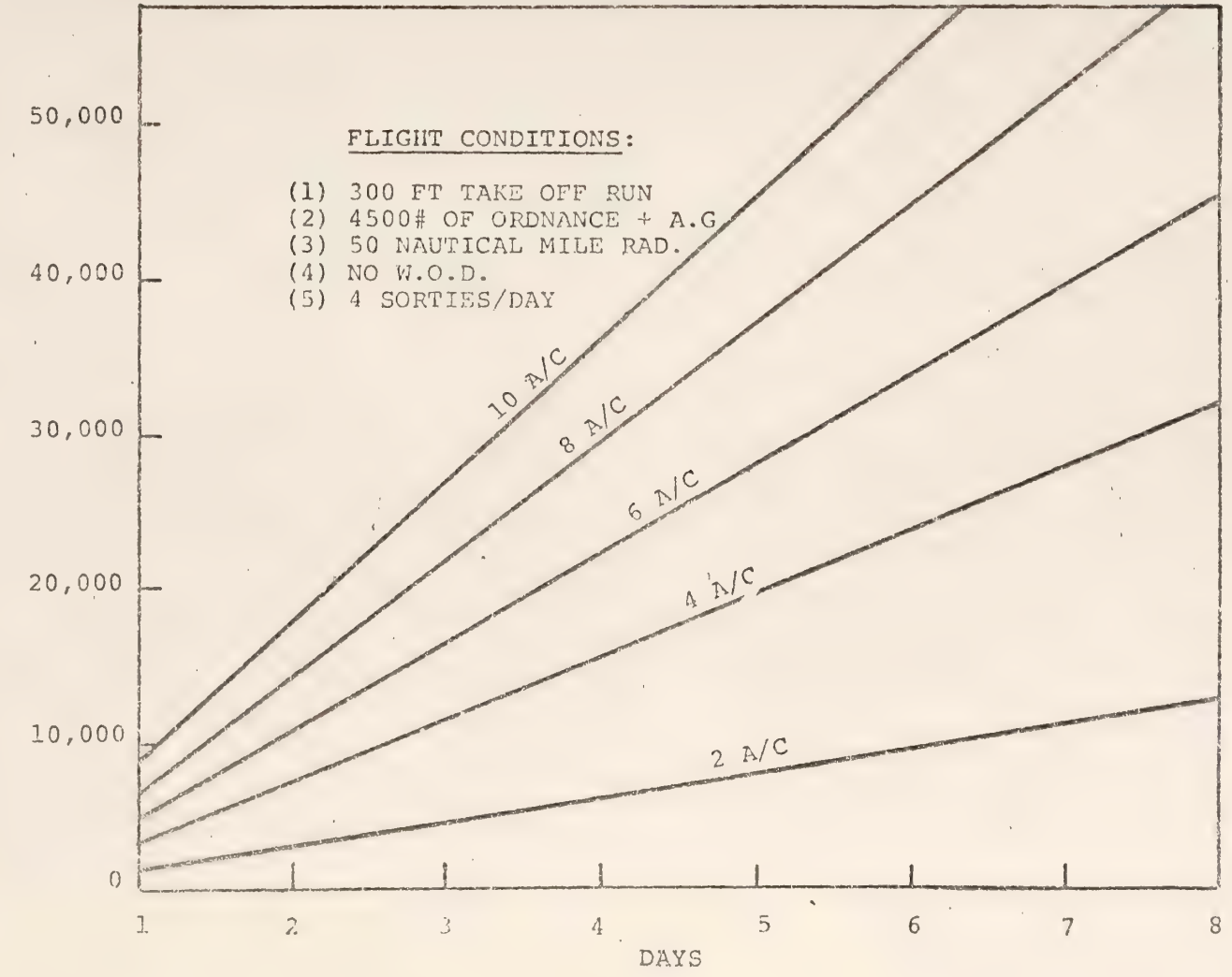


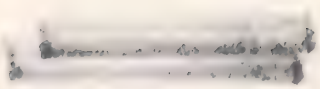


FIGURE C-5-15

(U) ORDNANCE STORAGE VOLUME NECESSARY TO SUSTAIN AV-8A FLIGHT OPERATIONS







SASS holds and/or the trade off of LFORM type cargo space for air ordnance stowage is a tactical decision. Figure C-5-16 depicts an arrangement for stowage of AV-8A ordnance for the LPH.

b. Handling Equipment. A major consideration in establishing equipment requirements was the use of multipurpose equipment with minimum handling space requirement and compatibility with existing LFORM cargo handling procedure. The high percent of Rockeye cluster bombs, which require no assembly, limits the assembly equipment requirements. The variety of CAS weapon types being limited to Rockeyes and 500-pound bombs plus guns greatly simplifies equipment requirements which are listed in Section 3. The quantity of equipment is established on the basis of an operational tempo of two AV-8A's per launch. Since the AV-8A's air-to-air capability is limited, only a contingency stock of equipment is embarked, thereby holding peculiar handling equipment to a minimum. The Aden gun requires extra ammo containers for preloading purposes.

c. Ordnance Flow. Air-launched ordnance will follow the same general paths as palletized cargo between the stowage holds and the hangar deck. By approaching air-launched ordnance as much as possible as cargo, it is felt that there will be a minimum interference in normal traffic patterns aboard Sea Bases. In this regard, only one method of weapon flow from a suitable stowage area to aircraft is presented. Figure C-5-17 illustrates this ordnance flow route for the LPH. The flow activity peculiar to each weapon is discussed below.

(1) Rockeye Flow. Rockeyes will be stowed in the MK-18 shipping cradle consisting of two weapons per container. The containers will be transferred to the cargo elevator for movement to the hangar for breakout. The weapons will be lifted from the MK-18 cradle manually with MK-19 bomb carriers or using a forklift with adapter and loaded directly onto the Aero 21A skids. The weapons will then be moved to the aft deck elevator for transfer to the flight deck. The skid is then moved beneath the respective aircraft wing station, and the bomb is manually lifted to the aircraft ordnance rack with the Rockeye hernia bar or a mechanical MK-8 type hoist. The weapon is then secured to the rack and safety pins are installed.

(2) MK-82 Bomb. The MK-82 bomb consists of the basic bomb body and two types of tail fins. Each component is palletized separately. For this study, an even mix of Snakeye and conical fins is used. The MK-82 bombs and tail

FIGURE C-5-16

(U) A RECOMMENDED ARRANGEMENT FOR STOWAGE OF AIR-LAUNCHED ORDNANCE FOR LPH SHIPS (HOLD 2, 4TH DECK)

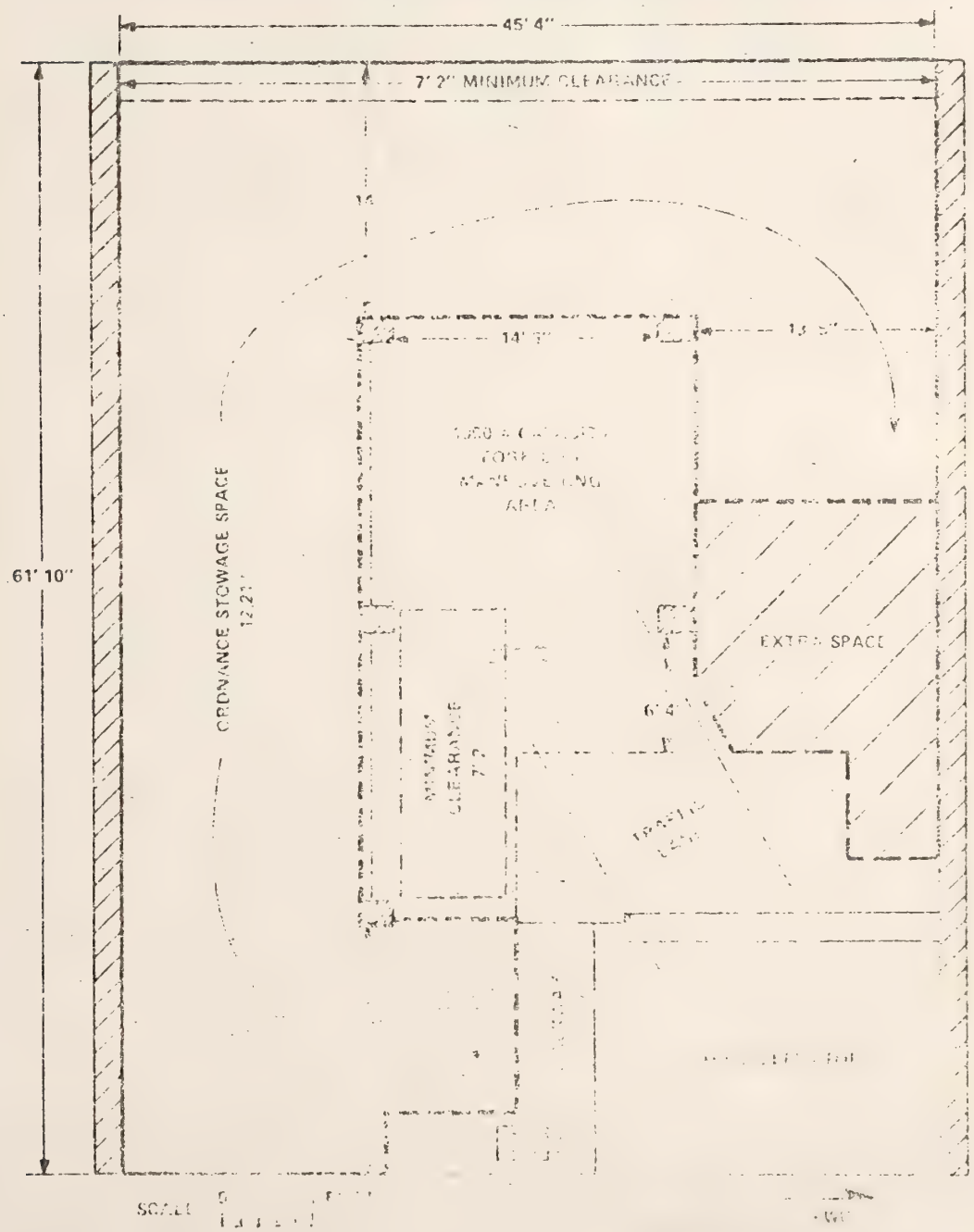
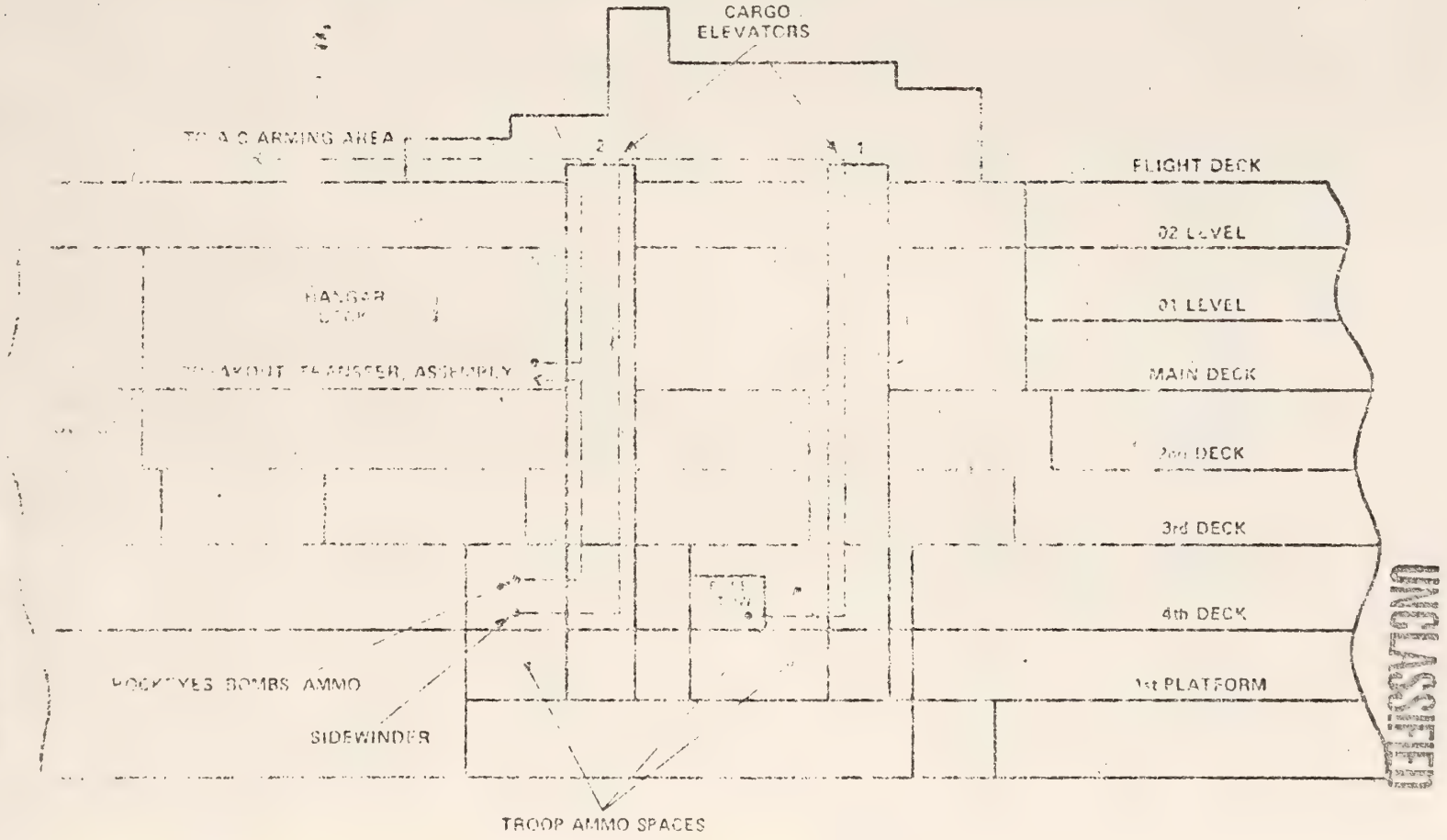


FIGURE C-5-17

(U) ORDNANCE AND ORDNANCE COMPONENTS FLOW ON LPH-2 CLASS SHIPS



UNCLASSIFIED

fins will follow the same flow as the Rockeyes. Assembly of the bombs will be accomplished in the hangar; the bomb bodies are removed from the pallet and placed on the Aero 12 B/C skids using a forklift with an adapter. The tail fins will be manually moved to the bombs and attached. A small fuze adapter will be inserted in the bomb nose after removal of the nose ogive. Two lugs are also inserted. The bomb is then ready for movement up to the flight deck and manually loaded using the hernia bar or the MK-8 type hoist connected to the rack. The weapon is secured firmly to the rack and fused (mechanical type). Safety pins are then installed. The bomb fuzes require stowage in the pyrotechnic locker area and are transported via Aero 12 B/C skids with Aero 9C adapter directly to the flight deck arming area. The ancillary items (i.e., arming wire, Fahnstock clips, boosters, lugs) require very little storage area.

(3) 30mm Ammunition. The ammunition will likewise follow the general flow pattern. The hangar deck will be used to unpack and to load the ammunition into the extra aircraft gun ammunition containers which are then struck up to the flight deck arming area for loading.

(4) Sidewinder Missile. The number of Sidewinder weapons will be very limtied as discussed in paragraph 304. The Sidewinder missiles are shipped completely assembled in the MK-16 Mod 0 storage cradle (except for wings and fins). The wings and fins are shipped in separate pallets and will have to be mounted to the missile bodies in the hangar prior to being moved to the flight deck. This assembly can be easily done on either Aero 12 B/C or Aero 21A skids using the Aero 30A-2 and Aero 8C-1 adapters. The Sidewinders will then be loaded manually on to the aircraft.

d. Strike-Up Time. The high percentage of the all-up Rockeye being used by the AV-8A indicates that there should be no problem in maintaining sufficient ordnance flow to sustain the proposed sortie rate during an assault or sustained operations.

506. (U) LHA-MAU Operation Including the AV-8A. The LHA, as discussed in Section 3, has an operational capacity of 38 CH-46 helicopters. Trade offs with AV-8A show this ship will be able to support a complement of 24 CH-46 helicopters and 10 AV-8A aircraft. A base case will be established for the ship-to-shore troop movement during an assault operation with the same criteria as that of the LPH assault. That is, the LHA is standing 20 miles offshore and must land one BLT and its support equipment with its complement of helicopters. (Although the LHA has the capability to off-load troops with

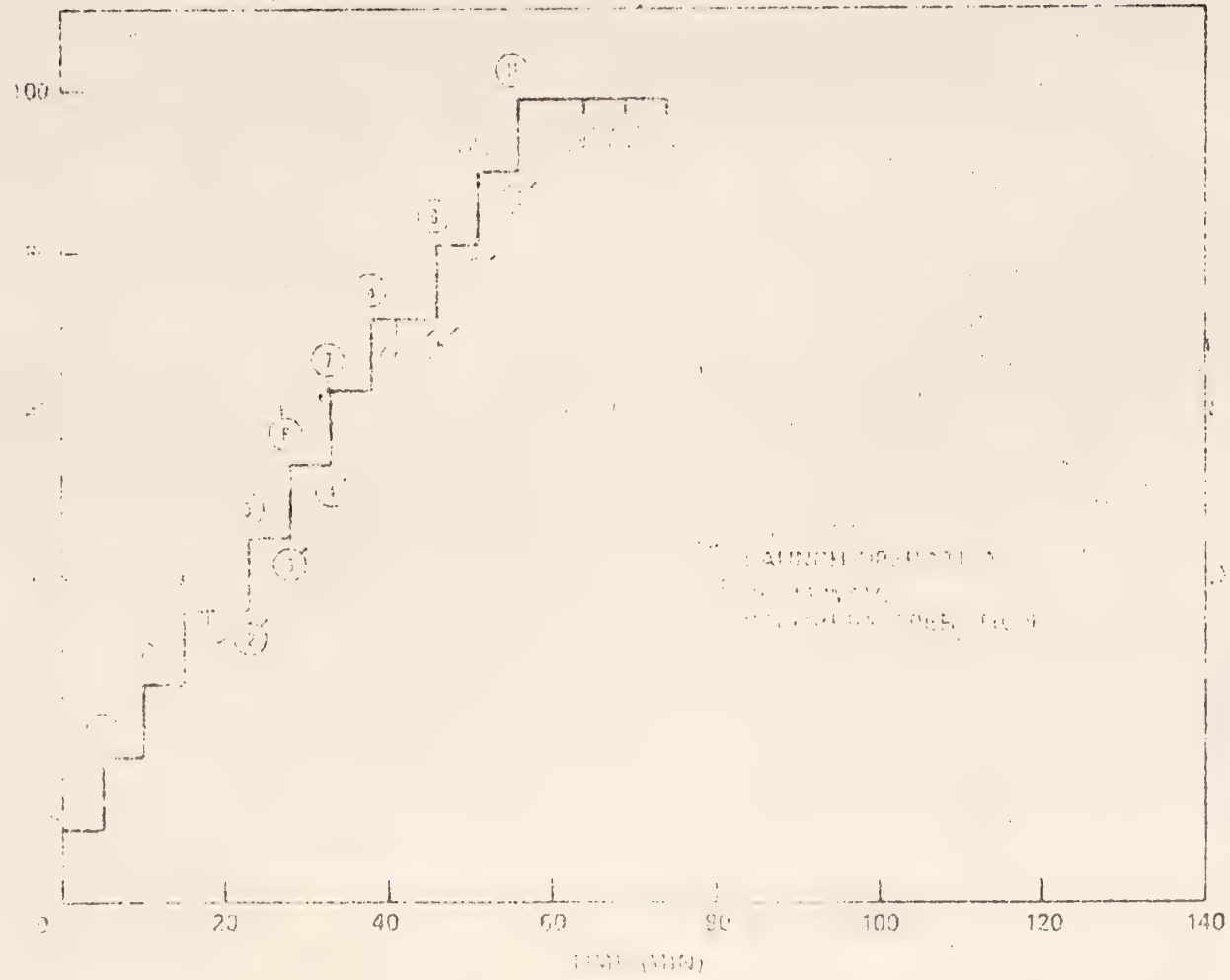
landing craft, as well as helicopters, this mode will not be considered here.) The flight deck has nine landing spots from which to operate the CH-46, and for our base case, 36 of the 38 helicopters will be used. Eleven waves of nine helicopters per wave are required to provide the 99 CH-46 sorties needed to move the BLT and its support equipment. The sequence of helicopter waves required for the ship-to-shore movement is shown in Figure C-5-18. The off-loading time is found to require 56 minutes. For AV-8A supported landings, the entire complement of helicopters and AV-8A's will be used with no attrition for either during the asault. Six of the 10 AV-8A's will be used to support the initial assault waves in flights of two, while the remaining four are held on call for support when needed. This concept will be considered while utilizing the AV-8A in extensive STO and exclusive VTOL operations.

a. Extensive STO During the Initial Assault. The AV-8A, in this instance, will utilize a minimum take-off roll of 300 feet.

(1) The assault air operations for the LHA will proceed in the same manner as for the LPH. The complement of 24 helicopters will be divided into three waves of eight helicopters. With a total of 10 AV-8A's available, it will be possible to supply each of the first three helicopter waves with a flight of two AV-8A's as close-air support. The remaining four AV-8A's will be armed and maintained on the deck in an on call status. The one LPD and one LSD in the Task Force provide support for the air operations. Turnaround service is provided by the LPD with the LSD serving as a staging platform providing fuel and demineralized water only. Total off-loading time for a typical AV-8A STO supported assault operation is found to be 99 minutes. The sequence and timing for this case is shown in Figure C-5-19. As with the LPH STO operations, it will be necessary to orbit the second and third waves of helicopters about the ship while the first wave is departing. This allows for a clear flight deck for AV-8A STO following the first wave. The second wave of helicopters then comes aboard while the third remains in orbit. The second flight of AV-8A's follows the second helicopter wave. The third wave of helicopters now comes aboard the LHA, is loaded, and departs for the beach followed by the third flight of AV-8A's. This sequence finds the first wave of helicopters back at the LHA just prior to the departure of the third wave. This wave will be required to orbit the ship until the departure of the third AV-8A flight, a period of about 7 minutes. The second helicopter wave is also required to wait, approximately 2 minutes, for a clear flight deck on its return from the assault area.

FIGURE C-5-18

(U) SEQUENCE OF CH-46 WAVES TO LAND BLT AND SUPPORT EQUIPMENT FROM AN LHA (BAD CASE)

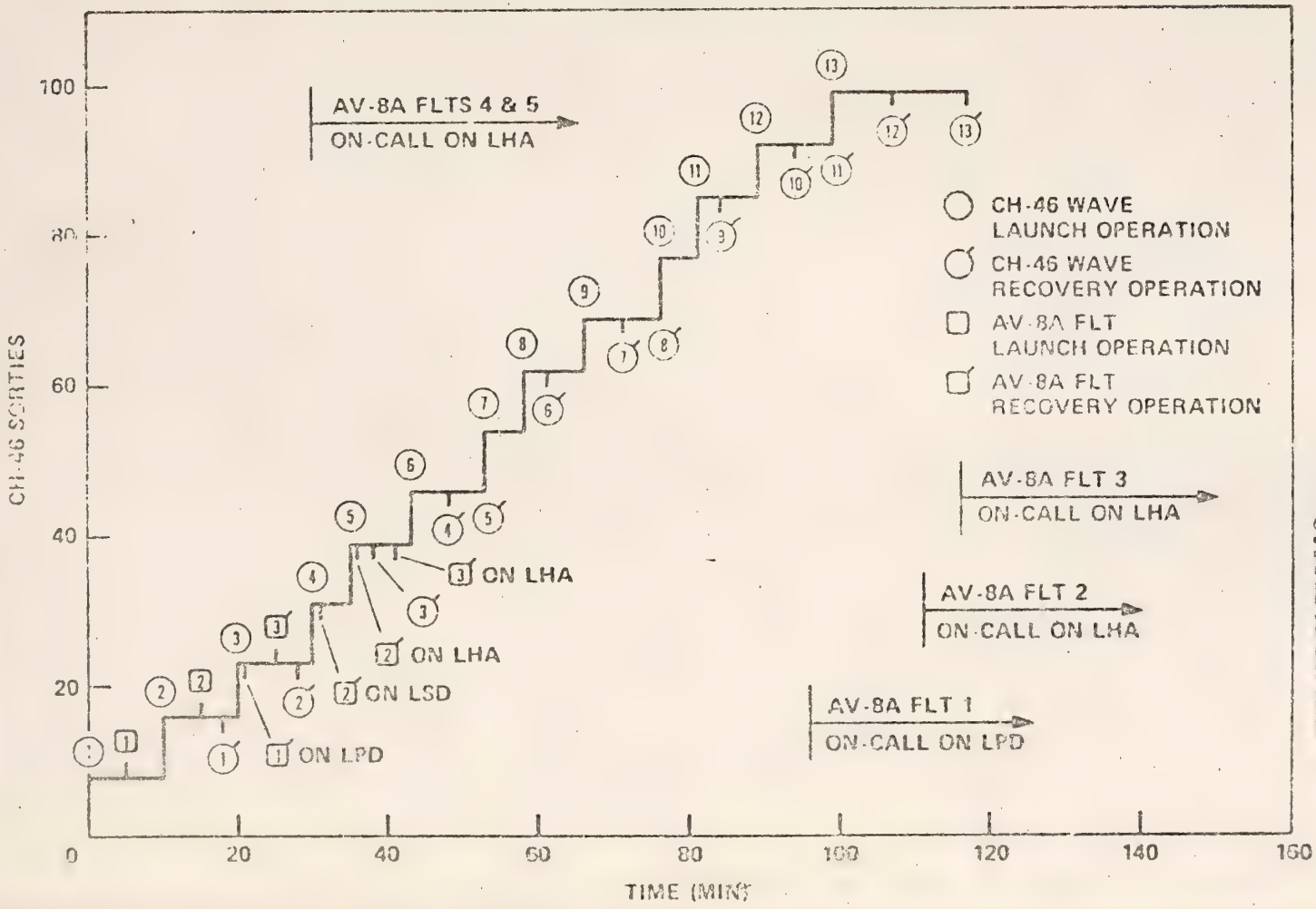


UNCLASSIFIED

UNCLASSIFIED

FIGURE C-5-19

(U) SEQUENCE OF CH-46 WAVES AND STO AV-8A FLIGHTS DURING AN ASSAULT FROM AN LHA WITH AN LPD AND AN LSD IN SUPPORT



UNCLASSIFIED

UNCLASSIFIED

Beyond this point, each returning helicopter wave finds a clear LHA flight deck and no wait is required. The first flight of AV-8A's return from the assault area 16 minutes after its departure from the LHA, or 21 minutes into the assault operation, and lands (VL) on the LPD where it is provided with turnaround service. This flight is ready for further service 75 minutes later or just prior to the departure of the 13th helicopter wave. The second flight of AV-8A's returns to a busy LHA flight deck and is required to stage from the LSD, coming aboard the LHA after the departure of the fifth helicopter wave. The third flight of AV-8A's is able to come aboard the LHA directly on its return from the assault area. The second and third AV-8A flights are brought below and turned around, being ready for further service at points 111 and 116 minutes after the start of the assault. The fourth and sixth AV-8A flights could be called at any time after the departure of the fourth wave of helicopters. These flights would depart the LHA in an STO mode between helicopter waves. The calling of these flights may or may not cause a further delay in the landing sequence depending on when they are called. In any case, the worst situation would require a delay of 5 minutes for each flight. The return to the LHA of these two flights would find a number of options available. If both flights were called, then the LHA fantail would be available for landing, on their return, regardless of the status of the forward part of the flight deck. However, if the forward deck is busy, then one flight may be required to stage from the LSD, coming aboard the LHA between helicopter waves. The entire landing operation is found to require 99 minutes to depart the LHA or 43 minutes longer than the base case of 36 helicopters and no AV-8's.

(2) The sequence of events required in this operation was followed through, using scale models as with the LPH. Figure C-5-20 shows the LHA flight deck just prior to the departure of the first helicopter wave. The first three flights of the AV-8A's are shown ready to follow each of the first three helicopter waves. Figure C-5-21 shows the take-off roll of the first AV-8A and illustrates, through the overlay in that figure, that sufficient clearance exists between the exhaust of the rolling jet and those remaining. This sequence is repeated for the second and third helicopter waves with, of course, a reduction in the number of AV-8A's remaining on deck following each successive wave. Figure C-5-22 shows AV-8A flights #4 and #5 being prepared for service with flight #4 being subjected to INAS alignment and flight #5 being armed. Figure C-5-6 shows flight #1 coming aboard the LPD after completion of its mission, and Figure C-5-7 shows the second flight landing on the LSD in preparation for staging to the LHA. Figure C-5-23 illustrates this

FIGURE C-5-20

(U) THREE AV-8A FLIGHTS AND A WAVE OF CH-46 HELICOPTERS ON THE FLIGHT DECK OF THE LHA



FIGURE C-5-21

(U) AV-8A FLIGHTS ON STO TAKE-OFF ROLL ON THE LHA



UNCLASSIFIED

UNCLASSIFIED

FIGURE C-5-22

(U) TWO AV-8A FLIGHTS BEING PREPARED ON THE LHA HANGAR DECK



FIGURE C-5-23

(U) AV-8A VTOL CAPABILITY ON THE LHA DURING OPERATIONS WITH SEVEN CH-46 HELICOPTERS ON THE FLIGHT DECK



UNCLASSIFIED

UNCLASSIFIED

flight coming aboard the LHA while flights #4 and #5 are standing by for on call service. This figure is also indicative of flight #3 coming aboard the LHA directly on its return from the assault area. These two flights are taken below and provided with turnaround service, leaving the flight deck clear for further operations.

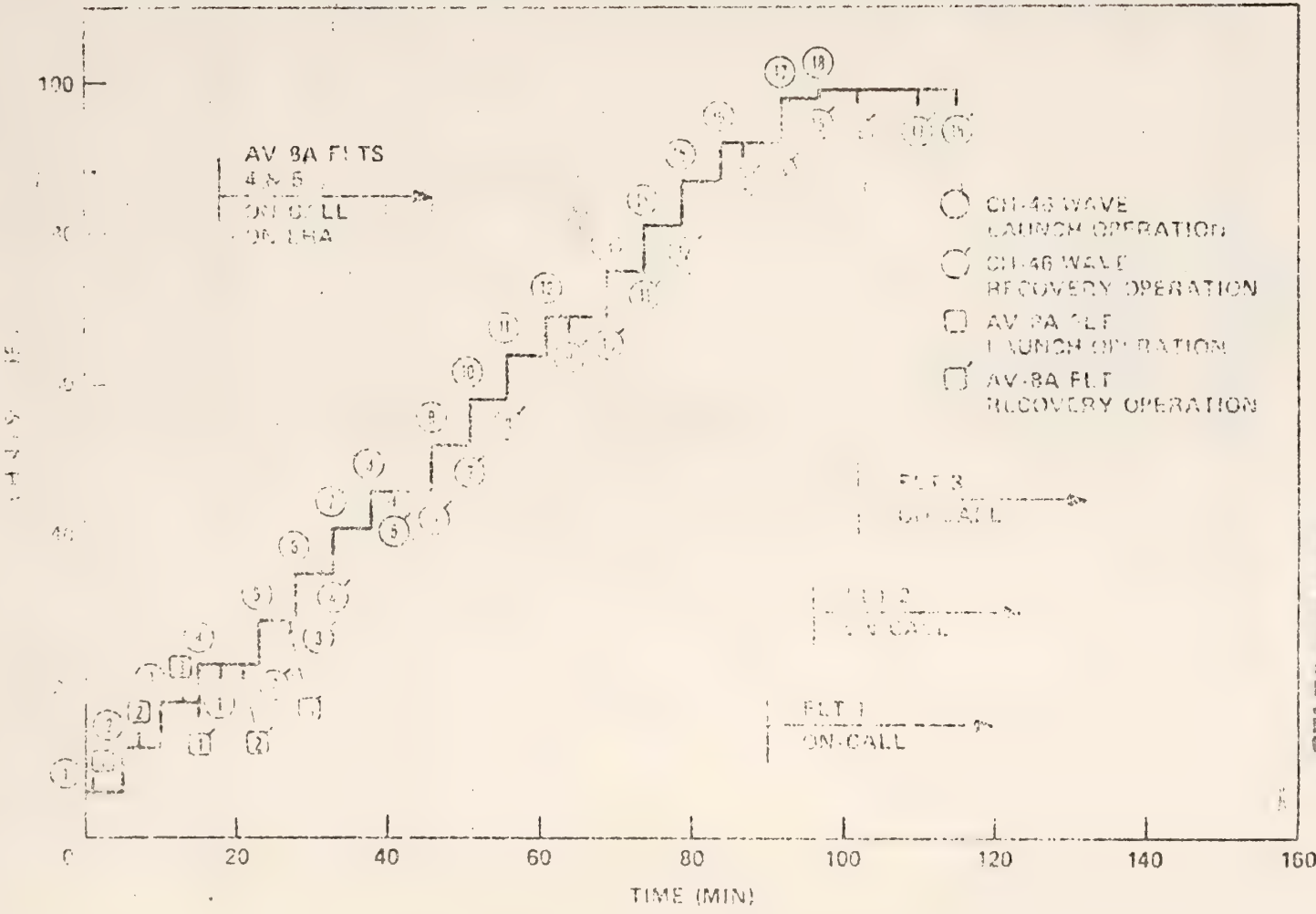
b. Exclusive VTOL During the Initial Assault. In this mode of operation, the aft portion of the LHA flight deck is used exclusively for AV-8A operations. The helicopters are restricted to the seven forward landing spots.

(1) The same basic plan of operation as used in the STO case is used for VTOL operations. The first three waves of helicopters are provided with close air support (each wave is supported by one flight of AV-8A's) while two flights of AV-8A's are held in an on call status. With 24 CH-46 helicopters and seven landing spots available, a variety of wave sizes and sequences is possible. For the test assault operation presented here, waves of six helicopters are used. This wave setup, though not utilizing all of the seven available landing spots, provides extra deck area for staging cargo or emergency landing or parking aircraft or staging air-launched ordnance. As with VTOL operations on the LPH, CH-46 waves are launched every 5 minutes with an 8-minute interval after every fourth wave. AV-8A VTOL operations do not slow down the cycling of helicopter waves. Prior to the assault, it is necessary to orbit 18 CH-46's about the ship in order to keep the spaces between the initial assault waves at a minimum. Figure C-5-24 shows the sequence of CH-46 waves and AV-8A flights. Note that no operations are shown as conducted from either the LPD or the LSD. This is an indication of the self sufficiency of the LHA in air operations and is also an indication of the further degrees of freedom available in the assault air operations. The off-loading is found to be 97 minutes. This is only 2 minutes less than the STO case because the final wave consists of only one helicopter. If the wave sizes are changed to seven, six, six, and five, the off-loading time will reduce to 92 minutes.

(2) Figures C-5-22 and C-5-25 represent two phases of VTOL operations. As discussed previously, Figure C-5-22 shows a possible hangar configuration. Figure C-5-25 shows the LHA flight deck with six helicopters forward on spots one through six and six AV-8A's aft, one of which is taking off. It is important to note that there is adequate separation between the operating AV-8A and the five parked aircraft. There is sufficient space remaining for parking aircraft, staging cargo, or emergency landing on spot number seven. An area is also designated for a bomb farm if arming on the

FIGURE C-5-24

(U) SEQUENCE OF CH-46 WAVES AND VTO AV-8A FLIGHTS DURING AN ASSAULT FROM AN LHA



UNCLASSIFIED

UNCLASSIFIED

[redacted]

FIGURE C-5-25

(U) AN AV-8A FLIGHT DEPARTS THE LHA WHILE A HELICOPTER WAVE IS LOADED

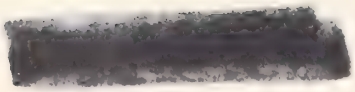


flight deck is desired. Figure C-5-25 is also indicative of returning aircraft showing they can be landed and brought below on the port side elevator, at any time, thereby eliminating the need for LPD and LSD support while operating in the VTOL mode exclusively.

507. (C) Air-Launched Ordnance Handling and Stowage on the LHA. This paragraph presents that information which is peculiar to the LHA. Those areas which are common to both the LPH and LHA are discussed in paragraph 505.

a. Ordnance Storage. Figure C-5-15 presented the air-launched ordnance storage space required in terms of volume per aircraft per day as determined from criteria outlined in Table C-3-5 and Annex G. For 5 days of full operation, 10 AV-8A's require approximately 39,000 cubic feet of ordnance

[redacted]

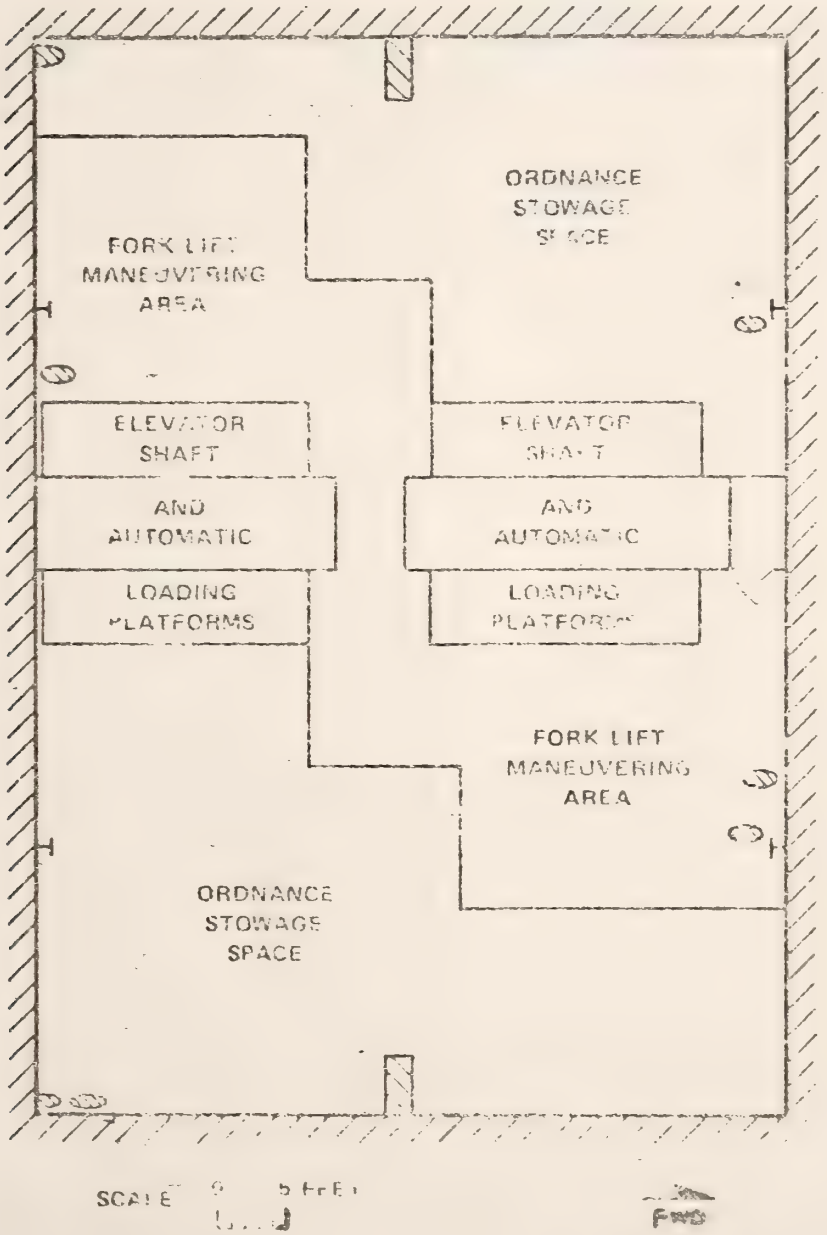




[redacted]

FIGURE C-5-26

(U) METHOD TWO ARRANGEMENT OF HOLD V INNER BOTTOM



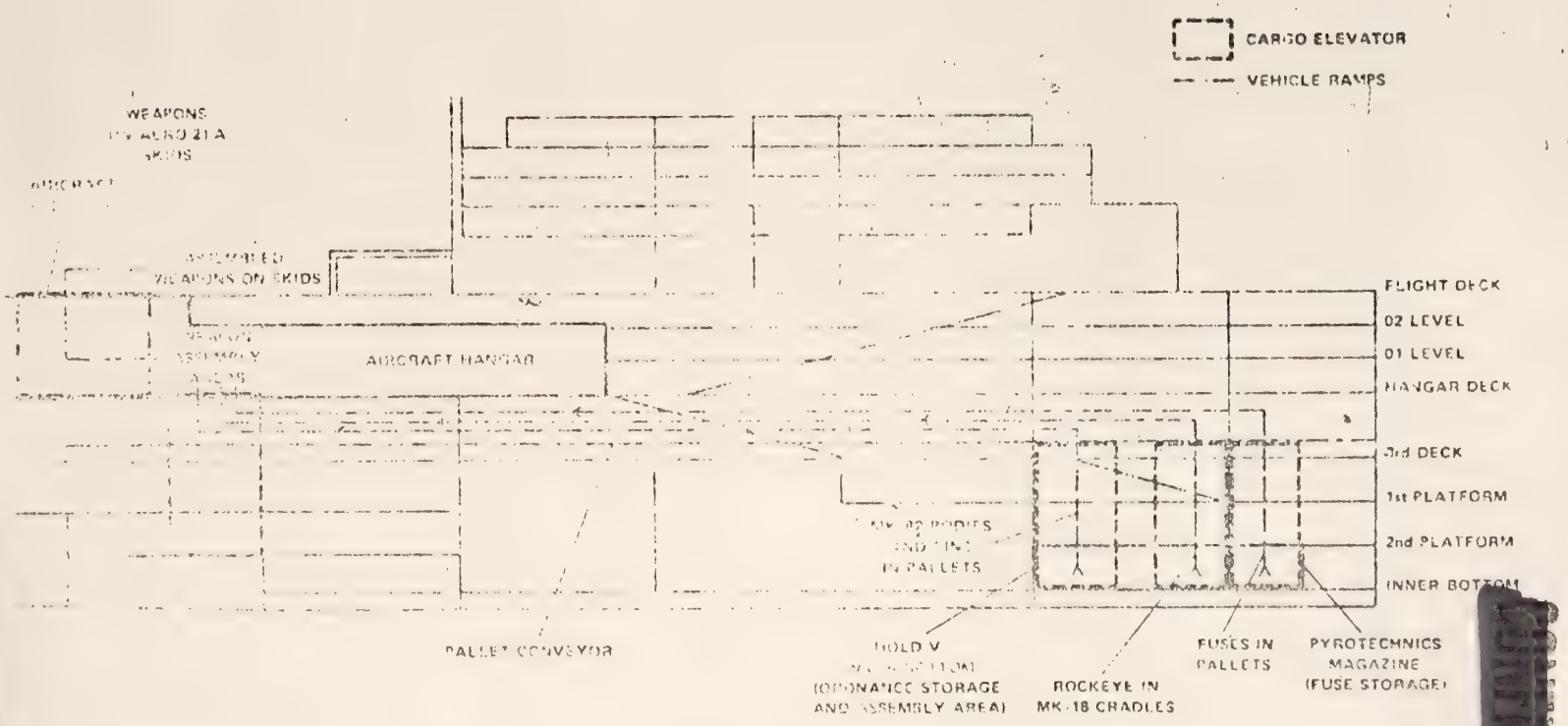
[redacted]

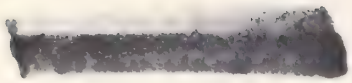




FIGURE C-5-27

(U) ORDNANCE FLOW







[redacted]

stowage space. Final determination of which holds to use is an operational consideration, but for the purpose of illustration, Hold V Inner Bottom is shown in Figure C-5-26 with a possible ordnance stowage arrangement.

b. Handling Equipment. Handling equipment is described in detail in paragraphs 304 and 505b.

c. Ordnance Flow. As with the LPH, air-launched ordnance will follow the same paths as cargo ordnance. Figure C-5-27 depicts one possible flow path on the LHA. This path utilized the cargo elevators and the horizontal pallet conveyor to transport ordnance (in pallets or cradles) to the hangar. Once in the hangar, the ordnance is moved to the assembly area by forklift or pallet transporter. After the ordnance is assembled or decanned, it is taken to the aircraft arming area on the flight deck via either of the aircraft elevators.

[redacted]





[redacted]

SECTION 6. SUMMARY (U)

601. (U) General. All ships currently in the Navy's inventory (or programmed) and having a landing platform were considered as candidates for AV-8A Sea Base or Sea Platform. Minimum criteria for landing platforms were established and all ships satisfying these criteria were evaluated as to their capability in providing support in the following areas:

a. Maintenance. Full support requires organizational (OMA) and intermediate (IMA) maintenance.

b. Ordnance. Full support requires storage, assembly, and handling of ordnance for four sorties per day per aircraft.

c. Fueling. Fuel storage and pressure refueling are necessary for full support.

d. Billeting. Berthing for extra hands required to service, maintain, and arm the AV-8A.

e. Flight Deck or Landing Platform. May or may not provide for rolling take-off and landing as well as vertical take-off and landing.

f. Communications, Control, and Landing Aids. To provide for all-weather support of the landing; requires capability to launch and recover Av-8A missions under instrument (IFR) conditions.

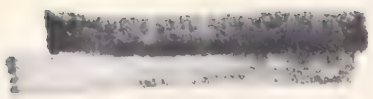
602. (C) Sea Bases. The LPH, LHA, CVS, and CVA were determined to be capable of meeting the criteria established for Sea Bases. The group of ship types, as listed above, are in the order of ascending AV-8A support capability. Each ship type was examined and all were found to be adequate in capability with the following qualifications:

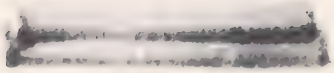
a. All ships may either have to be supplied with or have their systems made compatible with AV-8A INAS alignment equipment to provide full system capability.

b. The LPH and LHA may require the addition of two INAS service vans in order to provide the required IMA level of maintenance. The CVS and CVA may require some equipment p[illegible] to the AV-[illegible] accomplish the same functions.

c. The LPH and LHA will require a trade off of Landing Force Class V (or Special Weapons) ordnance in order to stow air-launched ordnance.

[redacted]





[redacted]

d. The LPH and LHA will have to be provided with air-launched ordnance handling equipment. Individual CVS's may require some additional handling equipment.

e. The LPH and LHA will have to be supplied regularly with liquid oxygen for pilot support.

f. Landing aids on all ships are considered adequate pending operational evaluation.

603. (C) AV-8A Sea Platforms. Data presented in Section 4 of this Annex establishes that the LPD-1, LPD-4, LSD-36, LCC-19, AE-21, AE-23, AE-26, AOE-1, and AOR-1 class ships meet the minimum criteria for a Sea Platform by having a platform of suitable size and strength for AV-8A landings and take-offs. Some other noteworthy characteristics are:

a. All of the above ships have duel storage and handling facilities compatible with AV-8A.

b. All of the above ships, except the LCC-19 and LSD-36 classes, have some capability for aviation ordnance stowage and handling (provided the appropriate equipment is supplied).

c. The LPD-1 and LPD-4 class ships are well suited to provide AV-8A turnaround service, including rearming.

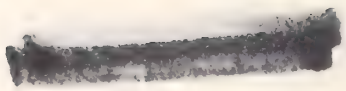
d. None of the potential Sea Platforms has a capability for IMA. Mission turnaround checks can be performed by squadron maintenance personnel embarked on the platforms to support specific tasks. Higher level maintenance can be accomplished, when necessary, by flying the appropriate personnel and their equipment to the Sea Platform from a Sea Base.

e. As with the Sea Bases, landing aids on Sea Platforms are considered adequate pending operational evaluation.

604. (C) Sea-Based Operations. The consideration of sea based operations was limited to operations aboard the LPH and LHA during an amphibious assault and for sustained operations from the LPH.

a. LPH Operations. An amphibious assault was considered wherein a Battalion Landing Team (BLT) and its support equipment was off-loaded from the LPH from a point 20 miles from the assault area. AV-8A support was provided, in flights of two, for the first two helicopter waves with a third flight standing by in an on call status beyond that

[redacted]





point. AV-8A support was considered for two cases wherein the aircraft was operating in the STO mode exclusively and in the VTO mode exclusively. In both instances, an LPD and an LSD were available as auxiliary landing platforms.

(1) The time to land the BLT and its support equipment was found to take 46 minutes longer when AV-8A support was provided using STO operations exclusively and 41 minutes when limited to VTO operations.

(2) It was determined that ordnance flow aboard the ship was sufficient to support this level of AV-8A operations.

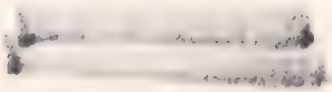
(3) Sustained AV-8A operations aboard the LPH was found to be feasible with the AV-8A restricted to the VTOL mode only.

b. LHA Operations. Operational considerations on the LHA were restricted to the amphibious assault. The assault landing was carried out from a point 20 miles offshore and again involved the landing of a BLT and its support equipment. In this instance, a total of 10 AV-8A's was considered, as opposed to the six aircraft operating from the LPH, with the restriction of exclusive STO in one instance and VTO in another. Close-air support, in flights of two, was provided for the first three helicopter waves, and two flights were maintained in an on call status after the first three waves. An LPD and an LSD were available as auxiliary landing platforms.

(1) The time to land the BLT and its support equipment was found to take 43 minutes longer when AV-8A support was provided using STO operations exclusively and 36 minutes when limited to VTO operations.

(2) Ordnance flow was sufficient to support the proposed sortie rate.





[redacted]

(U) REFERENCES

1. Naval Air Test Center, Preliminary British Carrier Suitability Evaluation of the HARRIER G.R. Mk 1 Aircraft, PT-52R-70, 28 May 70 (Unclassified).

2. Chief of Naval Operations, HARRIER (AV-8A) Aircraft Non-Aviation Ship Compatibility Study (Preliminary) (U), 13 Aug 70 (Confidential).

3. U.S. Naval Air Engineer Center, Helicopter Operating Facilities Bulletin No. 1, 19 May 69 (Unclassified).

4. U.S. Navy Ship Systems Command, HARRIER (AV-8A) Ship Compatibility Study Supplement No. 1 (U), COMNAVSHIP-SYSCOM ltr 6162:AT:jg C-9830 Ser: 0264-6162 11 Aug 70 (Confidential).

5. U.S. Naval Air Engineering Center, Non-Aviation Ships Helicopter Facility Resume, NAEC-ENG-7576, 16 Oct 69 (Unclassified).

6. Marine Corps Development and Education Command, Helicopter Requirements for Landing Force Operations Ashore (Update) (U), Project No. 30-69-06, 14 May 70 (Secret).

7. USS Guadalcanal, Ship's Loading Characteristics Pamphlet: United States Ship Guadalcanal, Jul 69 (Classified).

8. Chief of Naval Operations, Manpower Planning Factors for Aviation Activities (U), OPNAV Instruction 05311-3F, Nov 68 (Confidential).

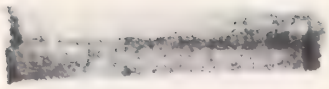
9. Chief of Naval Operations, Mix Stowage of Weapons (U), OP-34 Memo 0272-70, 1 May 70 (Confidential).

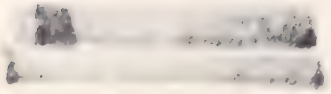
10. Puget Sound Naval Shipyard, LPH-2 Class Remove AVGAS, AVLUBE and Increase JP-5 Capacity, Sched. Ident. 700511, 19 Aug 70 (Unclassified).

11. New York Naval Shipyard, Booklet of General Plans CVA-11 (U), CVA 11-S-0130-992268 (Confidential).

12. New York Naval Shipyard, Booklet of General Plans CVA-14 (U), CVA 14-S-0103-1306439 (Confidential).

[redacted]





13. Naval Ships Systems Command, Booklet of General Plans for CVA-67 (U), Serial No. CVA 67-800-2267304 (Confidential).

14. Naval Air Systems Command, Air Weapon Facility Manual (CVA-67), Apr 70 (Unclassified).

15. Naval Air Engineering Center, USS SARATOGA WEPFACS, Apr 70 (Unclassified).

16. Naval Ships Systems Command, Hull Contract Plan CVA-66 (U), No. 800-1934138-44, 1 Aug 60 (Confidential).

17. Naval Ships Systems Command, Booklet of General Plans for CVA-43 (U), CVA 43-845-1126134 (Confidential).

18. Naval Ships Systems Command, Booklet of General Plans for CVA-14 (U), CVA 14-S-0103-1306439 (Confidential).

19. Chief of Naval Operations, Analysis of LPH/LHA Platform Requirements in Support of One MEF (U), OP-96/1s Ser 00414P96, Dec 69 (Secret).

CLASSIFIED BY... CMC (AX)
SUBJ TO GENERAL DECLASSIFICATION
SCHEDULE OF EXECUTIVE ORDER 11652
AUTOMATICALLY DOWNGRADED AT TWO-YEAR INTERVALS
DECLASSIFIED ON 31 DECEMBER 1979

WARNING
This material contains information affecting the National Defense of the United States within the meaning of espionage laws, title 18, U. S. C. sections 793 and 794. Its transmission



CONFIDENTIAL

CLASSIFIED BY GK2 (AA)
SUBJ TO GENERAL DECLASSIFICATION
SCHEDULE OF EXECUTIVE ORDER 11652
AUTOMATICALLY DOWNGRADED AT TWO YEAR INTERVALS
DECLASSIFIED ON 31 DECEMBER 1979

WARNING
This material contains information affecting the National Defense of the United States within the meaning of espionage laws, title 18, U. S. C. sections 793 and 794. Its transmission

CONFIDENTIAL

ANNEX D - AV-8A BASING (U)

SECTION 1. BASING REQUIREMENTS (U)

101. (U) General. This annex describes the austere forward basing concepts for the AV-8A. The spectrum of possible bases is divided into five categories:

a. Sea Base.

b. Sea Platform.

c. Main Base.

d. Facility.

e. Forward Site.

102. (U) Definitions. The types of bases are defined as follows:

a. Sea Base. A ship capable of transporting, stowing, and operating a complement of AV-8A aircraft. Rationale: It is desired to identify separately those ships which can provide support to operate the AV-8A for extended periods of time. These include the CVA, CVS, LPH, and LHA.

b. Sea Platform. A ship which provides a platform for landing and take-off and minimum support. Rationale: All ships on which the AV-8A can land or take-off other than Sea Bases fall into this category. The AV-8A cannot be supported on Sea Platforms for extended periods of time, but Sea Platforms may be used to launch or recover missions. The degree of support provided may vary among classes of ships, but the important distinction between a Sea Base and a Sea Platform is the latter's limited aeronautical logistical support capability.

c. Main Base. A location ashore which can provide all facilities and support required for extended operations of the AV-8A, including maintenance, personnel, basing, command and control, logistic support, and ordnance storage and handling. Rationale: Of the possible spectrum of the AV-8A bases ashore, the Main Base represents a base capable of fully supporting the AV-8A. There are two possible categories of Main Bases: (1) bases which combine support and operation of other fixed-wing aircraft or helicopters and the AV-8A, and (2) bases established exclusively to support and operate the AV-8A.

d. Facility. A location which can provide limited support for the AV-8A, including refueling, limited organizational maintenance, ordnance loading, forward personnel facilities, air operations support, and an area for landing and take-off. Rationale: The Facility represents a logical intermediate capability in the possible spectrum of bases. The Main Base provides full support, while the Forward Site, defined below, represents the minimum possible support. The capability of the Facility represents that required to turn around the aircraft for a subsequent sortie.

e. Forward Site. A location which is suitable for landing and take-off of an AV-8A. Rationale: The Forward Site represents the minimum possible support for AV-8A operation. Limited fuel and ordnance may be available at the Forward Site if the tactical situation permits.

103. (U) Sea Base and Sea Platform Characteristics. The characteristics of Sea Bases and Sea Platforms will vary depending on the capabilities of ships utilized. Annex C identifies ships capable of serving as Sea Bases and Sea Platforms and presents their pertinent characteristics.

104. (U) Main Base, Facility, and Forward Site Characteristics. The most important distinction among bases ashore is that a Main Base provides full support, a Facility provides a turnaround capability, and a Forward Site provides minimum support. The characteristics of these bases, summarized in Table D-1-1, can be deduced from this distinction and are discussed in paragraphs 106 to 110 of this section.

105. (U) Basing Concept. AV-8A operations in support of the landing force will occur in three distinct phases: Phase One features operations from seabases; Phase Two features emplacement of a facility; and Phase Three includes establishment of a Main Base.

a. During Phase One, fully armed and fueled AV-8A's will operate from Sea Bases. When required by the Commander Landing Force, AV-8A's can land ashore at Forward Sites and stand by for on-call missions from nearby ground units. This mode of operation is used when rapid response time is essential. By operating close to ground units which are fully integrated into the Marine Corps Air Command and Control System, the AV-8A will be immediately responsive to air support requests. When assigned a mission, the AV-8A will deliver ordnance on target and return to a Sea Base to rearm and refuel.

b. In Phase Two, the AV-8A will operate from a Facility. The AV-8A will be dependent upon Sea Bases for major

TABLE D-1-1. (U) BASE CHARACTERISTICS

	MINIMUM REQUIREMENTS		
	MAIN BASE	FACILITY	FORWARD SITE
Capability	Full Support	Turnaround	Land and Launch
Nominal No. of AV-8's	20	6 to 10	1 to 4
Maintenance	IMA, OMA	Limited OMA	None
Ordnance	Storage, Assembly, and Handling	Storage and Handling	None
Fuel	Storage and Refueling	Storage and Refueling	None
Billeting	400 to 500 Personnel	78 to 116 Personnel	None
Landing and Take-off Surface	1500' Strip	600' to 1500' Strip	72' x 72' or Existing Hard Surface
Landing Aids	All Weather	Day/TACAN Night	Minimum
Access	Road or Beach	Surface or Helicopter	Helicopter

logistical support during Phase Two operations, but will be capable of sustained, highly responsive close air support within the beachhead area. AV-8A's based at Facilities can provide sustained effective support to the ground commander. Hence, the need to emplace large, complex, and vulnerable installations for AV-8A operations will be minimal.

c. As the amphibious operation progresses, and if dictated by the situation, the AV-8A will enter Phase Three deployment which requires the establishment of the Main Base which will provide for complete support of AV-8A operations.

Once the Main Base is established, the AV-8A will be independent of the Sea Base and capable of operating from Facilities and Forward Sites supported from the Main Base. It is noteworthy that the Main Base, with complete AV-8A support, is considerably smaller than the most austere base which will support conventional fixed-wing aircraft. As a result, the AV-8A will be able to phase ashore more quickly and with much less base-preparation than any comparable aircraft in service today.

(1) Sea Based Operation. Afloat, the AV-8A will be operated from Sea Bases. When operating from a CVA or CVS, the AV-8A will operate together with the other embarked aircraft. When operating from an LPH or LHA, a detachment of AV-8A's will normally operate together with embarked helicopters. It is not envisioned that the AV-8A will be routinely employed from Sea Platforms; however, Sea Platforms may be used when dispersal of the AV-8A is desired.

(2) Staging Operations Ashore. The AV-8A can move ashore in the following manner:

(a) As soon as an appropriate location has been secured by the ground forces, a Facility can be started ashore. AV-8A's operate from the Sea Base until the Facility is prepared.

(b) Within 72 hours, the Facility will be able to accept the AV-8A, enabling turnaround of aircraft ashore. The Sea Base will continue to provide logistic support such as intermediate maintenance. If extensive bases ashore are not desired, AV-8A operations can continue from this posture, with major logistic support remaining aboard the Sea Base. Additional Facilities may be established as desired to support the scheme of maneuver.

(c) A Main Base will be established when full logistic support is desired ashore. If AV-8A's are operated together with other fixed-wing aircraft, the Main Base will generally be an expeditionary airfield for those aircraft as well. If a Short Airfield for Tactical Support (SATS) or other expeditionary airfield is to be established ashore, the AV-8A can begin operations from the field before its completion.

(d) Forward Sites can be used during all phases of operations when rapid response times are required by the ground commander. These Sites can also be used for the dispersal of aircraft in a high-threat environment.

(3) Operations Ashore. Facilities will continue to be established and relocated as desired to provide more responsive close air support for the ground forces, while the Main Base, once established, is not expected to be moved. The Main Base will provide logistic support for Facilities. The extent to which Facilities and Forward Sites are established and utilized will depend on the tactical situation.

106. (U) Main Base Characteristics

a. Twenty (20) AV-8A's. Since it is uneconomical to provide more than one complement of all support equipment, personnel, and facilities required for a squadron, it is desirable that a Main Base be capable of supporting an entire squadron, and that no more than one Main Base be established per squadron.

b. Maintenance. Full support requires intermediate (IMA) and organizational (OMA) maintenance.

c. Ordnance. Ordnance storage, assembly, and handling are necessary to provide full support.

d. Fueling. Fuel storage and pressure refueling are necessary for full support.

e. Billeting and Mess. The Main Base must be capable of billeting the full squadron plus supporting units. Depending on the situation, the total number of personnel needed to support the AV-8A at a Main Base would be 400 to 500.

f. Landing and Take-off Surfaces. The 1,500-foot surface allows short take-off (STO) at maximum gross weight. When AV-8A's are collocated with conventional aircraft, the runway length will be determined by conventional rather than AV-8A's criteria.

g. Landing Aids. For all-weather support of the landing force, it must be possible to launch and recover AV-8A missions in instrument (IFR) conditions.

h. Access. The amount of equipment needed to establish and resupply a Main Base requires that its location be selected adjacent to a road or beach.

107. (U) Main Base Location. The location of a Main Base must be selected with the following criteria in mind:

a. Tactical. The Main Base must be within operating range of potential AV-8A targets. Because of the trade-off

between range and ordnance payload, the Main Base should be within the amphibious objective area. The AV-8A's 265-nautical mile maximum operating radius with external stores (Annex B) may be considered a maximum for missions from a Main Base.

b. Installations Available. If hard surfaces such as a conventional airfield, SATS, or road are available, locating a Main Base at these installations minimizes the time and effort necessary to establish it.

c. Terrain. The terrain must allow a runway to be established without undue construction effort. As stated previously in this annex, a runway length of 1500 feet is desired. Obstacle clearance must be considered in establishing the Main Base.

d. Surface. A Main Base will generally require availability or installation of a prepared surface. The soil must provide a suitable foundation for this surface, which requires a California Bearing Ratio (CBR) of at least 10 percent (reference 1). According to the Aircrew Manual, overall gradient should not exceed 1 in 40, and local undulations should not exceed 6 inches peak to trough in 50 feet or 12 inches peak to trough in 100 feet, with no more than two peaks of the same wave length (reference 2).

e. Winds. Since the AV-8A has a crosswind limitation of 10 knots for STO between 30 and 90 knots lift-off speed, the runway should be aligned along the prevailing wind direction.

f. Logistics. The Main Base should be accessible by a road. For economy in transportation, it is desired to minimize the distance to the source of logistic support, especially fuel and ordnance.

g. Communications. As discussed in Annex E, it is necessary to provide the Main Base with adequate communication support.

h. Security. Because it is relatively immobile, a Main Base should be located in an area which is expected to remain secure throughout the operation. Ground forces should be available to provide protection from infiltration and sabotage, and the Main Base should be defensible from air attack.

108. (U) Facility Characteristics

a. Six to Ten AV-8A's. The number of AV-8A's at a Facility will be dictated by the tactical situation. A

number of Facilities affords maximum flexibility of employment at the cost of duplication of support equipment and personnel. A Facility should be capable of supporting at least one-third of a squadron, or six aircraft. The maximum number of aircraft may be increased; if the Facility must support over half the squadron for an extended period of time, it would be economical to upgrade that Facility to a Main Base. The normal number of aircraft at a Facility for an extended period would be six to ten AV-8A's.

b. Maintenance Capability. As a minimum, a Facility must be capable of refueling and rearming; however, as discussed in Annex B, the AV-8A requires a preflight/postflight inspection between missions, and corrective maintenance may be required. It is desirable that corrective actions not requiring extensive support equipment or repair parts be accomplished at the Facility.

c. Ordnance. Ordnance handling and adequate storage is necessary to rearm AV-8A's for mission turnaround.

d. Fueling. Pressure refueling is necessary for mission turnaround. Storage must be adequate to support the frequency of missions.

e. Billeting and Mess. The number of personnel at a Facility is estimated to be 78 to 116, as shown in Table D-1-2.

f. Landing and Take-off Surface. The Aircrew Manual (reference 1) establishes the criteria stated in paragraph 107d for gradient and local undulations. The AV-8A will normally return from missions having expended fuel and ordnance, so that vertical landings (VL) or rolling vertical landings (RVL) may be used. Take-offs may be vertical (VTO), rolling vertical (RVTO), or short (STO). The following are alternative surfaces for a Facility:

(1) Unprepared Surface. To minimize the probability of foreign object damage (FOD), an RVTO should be utilized as discussed in Annex B. To avoid FOD on landing, the landing must be an RVL at a touchdown speed of 50 knots or more. A CBR of at least 8 percent is required for repeated operations (reference 1).

(2) Available Hard Surface. VL, VTO, RVL, RVTO, and STO may be utilized as discussed in Annex B. A VL and VTO can be executed if the surface is adequate, but the Kestrel trails (reference 2) and Royal Air Force experience indicate that VL and VTO will damage macadam and some aged

TABLE D-1-2. (U) AV-8A FACILITY MANNING ESTIMATE

CATEGORY	NUMBER OF PERSONNEL 6 AV-8A's	10 AV-8A's	BASIS OF ESTIMATE
Command, operating & administration	4	4	1 command, 2 operations, 1 administration
Pilots	8	13	1.25 per aircraft
Maintenance			
Supervision	2	2	1x2 shifts
Flight Line	12	20	2 per aircraft
Specialists	6	12	1 or 2 each 6216, 6236, 6243, 6025, 6062, 6054
Ordnance handling	12	20	2 per aircraft
Administration	1	2	Estimated
Quality Assurance	1	1	Estimated
Fuel	7	7	TAFDS detachment
Ordnance support	4	7	Estimated
Supply	2	2	1x2 shifts
Utilities	6	10	Estimated
Airfield operations	6	6	3x2 shifts
Mess & support	7	10	10 percent
	78	116	

concrete. The availability of hard surfaces would depend on the number of roads and other installations in the landing force area.

(3) Prepared Surface. VL, VTO, RVL, RVTO, and STO may be utilized. Use of a prepared surface allows for maximum flexibility in operations. VTO gross weight limits the AV-8A payload compared to STO performance.

(4) STO is the preferred operating mode. As discussed in Annex G, the AV-8A will generally be stores station limited at seven Mk82 bombs or Rockeyes, plus the guns, for a

maximum ordnance load of 4,820 pounds. From Annex B, ground roll for a 50-nautical mile radius mission with this payload would be 400 feet. The desired runway length shown for a Facility allows for this take-off run, plus variation in performance among aircraft and pilots, for a total distance of 600 feet.

g. Landing Aids. It is considered desirable to provide a Facility, with equipment, to allow day/night VFR operations.

h. Access. As shown in Annex F, it is possible to support a Facility by air with a reasonable number of helicopters. Therefore, access may be by either surface or air.

109. (U) Facility Location. Criteria for locating Facilities are:

a. Tactical. The purpose of establishing a Facility is to improve responsiveness of close air support; therefore, it should be located close to the potential targets.

b. Installations Available. To improve AV-8A payload capability, it is particularly desirable that a Facility allow STO operations with as long a take-off run as possible, between 600 to 1,500 feet. This may be accomplished by engineer effort or by locating a Facility at a road, airfield, or other available hard surface.

c. Terrain. The terrain criteria discussed in paragraph 107c above are applicable.

d. Surface. The surface criteria discussed in paragraph 107d above are applicable.

e. Winds. The considerations for winds discussed in paragraph 107e above are applicable. For VTOL operations, the maximum crosswind is 15 knots.

f. Logistics. A Facility may be supported by either surface transport or helicopter, but surface transport is generally more economical. In either case, in the interest of minimizing transportation requirements, the distance to the source of logistic support, usually the Main Base, should be minimized.

g. Communications. As discussed in Annex E, it is necessary to provide a Facility with adequate communication support.

h. Security. A Facility should be located so that ground force units can provide security without excessive sacrifice of their resources or flexibility. Protection from air attack should be provided by air defense and by camouflage and concealment.

110. (U) Forward Site Characteristics

a. Nominal Number of AV-8A's. The minimum possible number of AV-8A's at a Forward Site is one. The maximum number of AV-8A's at a Forward Site is considered to be four; if more than four AV-8A's were to be operated for an extended period of time, it may be more effective and economical to upgrade the Forward Site to a Facility.

b. Maintenance. For minimum support, no maintenance is performed routinely at a Forward Site. Maintenance personnel and equipment can be deployed to a Forward Site when needed. To minimize the support requirements, it is envisioned that AV-8A's would be deployed to Forward Sites in a mission ready status and kept prepared for immediate launch. The aircraft specification (reference 3) establishes that the AV-8A is capable of a 6-hour period on the ground under such conditions with no ground support equipment.

c. Ordnance. For minimum support, no ordnance loading or handling would be performed at a Forward Site.

d. Fuel. For minimum support, no refueling would be provided at a Forward Site.

e. Billeting and Mess. No assigned manning is required to support a Forward Site. Personnel would be dispatched as needed for only short periods of time.

f. Landing and Take-off Surface. The discussion of alternative landing and take-off modes at a Facility applies to a Forward Site as well. However, because a Forward Site is not self-sustaining, it should be capable of maximum flexibility in location, and it should be readily relocatable. It is therefore envisioned that a prepared or available V/STOL pad or road will normally be the landing and take-off surface.

g. Landing Aids. Minimum visual landing aids would be provided.

h. Access. Since minimum support is provided, helicopter access should be sufficient.

111. (U) Forward Site Location. Criteria for locating Forward Sites are:

a. Tactical. A Forward Site must be located close to potential targets for rapid response.

b. Installations Available. If a suitable hard surface is available, a Forward Site can be established with minimum engineer effort.

c. Terrain. The major terrain requirement is the potential to establish a minimum 72 foot by 72 foot VTOL pad plus parking area. Surrounding terrain must allow for approaches to a 50-foot altitude over the pad at a maximum flight path angle of 5 degrees.

d. Surface. A suitable hard surface is desired. If no hard surface is available, it is desired that the area selected provide a suitable foundation for a VTOL pad with minimum preparation.

e. Winds. For VTOL operations at a Forward Site, landing approaches may be from any direction unless surrounding terrain precludes adequate clearance. Transition to vertical landing must be possible into the prevailing winds.

f. Logistics. A Forward Site needs minimum logistics support, but it must be possible to land a CH-53 or CH-46 helicopter at or near the Forward Site to off load equipment and personnel if the location is not accessible by surface.

g. Communications. As discussed in Annex E, it is necessary to provide a Forward Site with adequate communication support.

h. Security. The same considerations apply as for a Facility.

112. (U) Employment. The type of base to be used can be determined in the following manner:

a. A Sea Base may be used:

(1) During amphibious operations prior to establishing a Main Base ashore.

(2) To support operations ashore when it is not feasible or desirable to establish bases ashore.

b. A Sea Platform may be used:

(1) As an alternate landing site at sea.

(2) To turn around missions if the Sea Platform has refueling and rearming capability.

(3) To launch AV-8A missions staged from a Sea Base when the tactical situation dictates a need for dispersal.

c. A Main Base would be used to support AV-8A operations ashore when it is desirable to locate the support ashore and a suitable location is available.

d. A Facility may be used:

(1) During amphibious operations prior to establishing a Main Base ashore.

(2) When expected size or duration of the operation does not warrant establishment of a Main Base ashore.

(3) To support dispersed AV-8A operations when tactical necessity dictates displacing AV-8A's forward in proximity to supported units to reduce response time.

e. A Forward Site may be used:

(1) During amphibious operations when required by the landing force commander to increase responsiveness.

(2) When tactical necessity dictates dispersal of AV-8A's.

113. (U) Sea Based Missions. Since a Sea Platform cannot provide the full support required to operate the AV-8A, a Sea Platform must be supported by a Sea Base for extended operations. Depending on the Sea Platform capability and AV-8A mission requirements, a Sea Platform may or may not be capable of turning around AV-8A's for subsequent missions.

a. The possible mission profiles from Sea Bases and Sea Platforms are illustrated in Figure D-1-1:

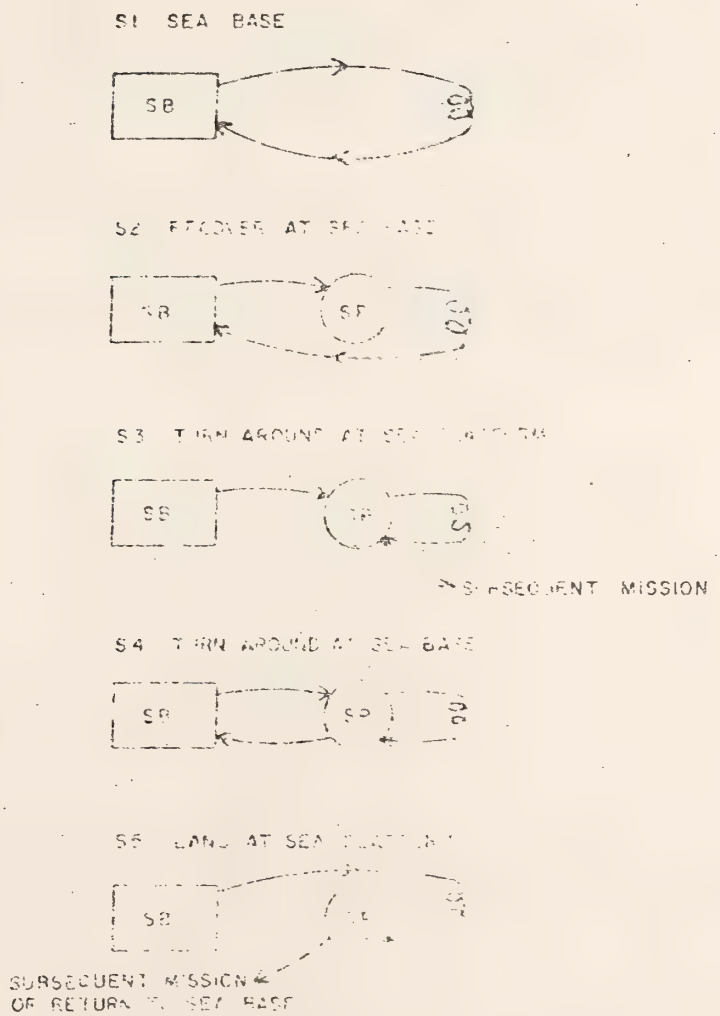
(1) Launch and recover at Sea Base (mission S1). This is the most efficient utilization of the aircraft, since no flying time is expended in staging aircraft to Sea Platforms.

(2) Stage from Sea Base to Sea Platform, launch from Sea Platform, recover at Sea Base (mission S2) or Sea Platform. Recovery at a Sea Platform may occur if it is capable of turning around missions and subsequent missions

UNCLASSIFIED

FIGURE D-1-1

(U) AV-8A SEA BASED MISSIONS



UNCLASSIFIED

from that Sea Platform are required (mission S3) or if operations at the Sea Base preclude an AV-8A landing until a later time. In the latter case, the AV-8A must later be flown to the Sea Base for mission turnaround (mission S4).

(3) Launch from Sea Base, recover at Sea Platform for turnaround or subsequent flight to Sea Base (mission S5). This would occur under the same conditions as missions S3 and S4.

b. Mission S4 in Figure D-1-1 has the undesirable characteristic of three landings and take-offs per mission accomplished. This results in increased engine life consumption and other maintenance related to landing and take-off cycles. Missions S2 and S3 each have two landings and take-offs per mission. Subsequent missions of type S3 and S5 can be accomplished with one landing and take-off. However, not all Sea Platforms can be manned and equipped for mission turnaround.

114. (U) Land Based Missions. Since the AV-8A Facility has only limited support capability and the AV-8A Forward Site has minimum support capability, either the Facility or Forward Site must be supported by a Main Base or Sea Base. The mission profiles illustrated in Figure D-1-2 are feasible for continuing operations from land bases and combined land and sea bases:

a. Launch and recover at Main Base (mission L1). This is the most efficient utilization of the aircraft, since no flying time is expended in staging aircraft to Facilities or Forward Sites and all support is centralized at the Main Base.

b. Stage from Main Base (or Sea Base) to Facility, launch from Facility, recover at Facility (mission L2) or Main Base (mission L3). Recovery at a Main Base (or Sea Base) may occur if it is known that the aircraft requires maintenance exceeding the capability of a Facility.

c. Stage from Main Base (or Sea Base) or Facility to Forward Site, launch from Forward Site, recover at Main Base (or Sea Base) or Facility (mission L4). Each mission accomplished requires two landings and take-offs.

d. Launch from Main Base (or Sea Base), recover at Facility (mission L5). This would occur under the same conditions as mission L2, except that the initial launch is from a Main Base (or Sea Base).

115. (U) Number of Bases. The potential number of bases can be established from their characteristics. While the number of bases in any particular situation will vary with the

FIGURE D-1-2

(U) AV-8A LAND BASED MISSIONS

L1 MAIN BASE



L2 FACILITY



L3 PROVOST AT MAIN BASE



L4 FORWARD SITE



L5 RECOVERY



MB- MAIN BASE
SB- SEA BASE
F- FACILITY
FS- FORWARD SITE

tactical support required, it is the purpose of this discussion to establish the maximum likely basing requirements.

a. Sea Bases. The capabilities of Sea Bases are examined in Annex C. While a single Sea Base could serve for an entire AV-8A squadron, in some cases, the aircraft could be based on more than one LPH or LHA. Certain functions such as IMA would then be centralized at one of the LPH's or LHA's. If the Sea Base is a CVA or CVS, it is envisioned that the entire AV-8A squadron would be embarked on one Sea Base. The number of Sea Bases will depend on the ships assigned to the amphibious task force and the number of AV-8A's required.

b. Sea Platforms. Annex C also examines the capabilities of Sea Platforms. The number of Sea Platforms will depend on the same considerations listed above for Sea Bases plus consideration of the degree of dispersal desired.

c. Main Base. The assignment of IMA functions to the Main Base and the economic desirability of centralizing support dictates that a squadron operate from a single Main Base. If conventional aircraft are brought ashore, it is desirable for reasons of economy that the AV-8A Main Base be established at the conventional aircraft base.

d. Facility. The need for Facilities is dependent on the tactical situation, the size of force supported, communications available, location and mission of supported units, weather, and terrain. The maximum requirement for Facilities is envisioned in a Marine Amphibious Force (MAF) operation, where two Facilities may be required to support two assault regiments. The third regiment, generally surface landed, would be supported from the Main Base.

e. Forward Site. The same considerations apply to establishing Forward Sites as for Facilities. The maximum requirement for Forward Sites is envisioned in support of the individual battalions of a regiment, where two Forward Sites and a Facility may be used to support the three battalions. The maximum dispersal of an AV-8A squadron would then call for one Main Base, two Facilities, and four Forward Sites (two per Facility). In practice, the desirability of dispersal will have to be balanced against the burden imposed on the security forces; the construction effort required; the logistic support required; the complexity of command, control, and communications entailed in dispersal; the requirements for massing AV-8A strikes; and the vulnerability of Forward Sites to enemy attack.

116. (U) Upgrading. The mobility of Forward Sites, Facilities, and Main Bases is in inverse order to the degree of support they provide. When a requirement is perceived to establish a Main Base or Facility at a particular location, it is often desired to begin operation at that location as soon as possible. For that reason, it should be possible to establish a Main Base incrementally from a Facility. This feature will be particularly applicable to movement ashore, facilitating earliest possible deployment of AV-8's to Facilities. It may also be desired to expand the Main Base to an expeditionary airfield for support of conventional jet aircraft.

SECTION 2. MAJOR SUPPORT EQUIPMENT AND LAYOUT (U)

201. (U) Purpose. This section describes the AV-8A support equipment and layout for land basing.

202. (U) Forward Site

a. The minimum layout requirement for a Forward Site is an area 72 feet by 72 feet, reasonably level, with an approach and departure corridor providing clearance from obstacles. The area may be defined by visual aid to assist in locating the Site and executing a vertical landing.

b. A small section of a large area; e.g., airfield, highway, parking lot, may be designated as a Forward Site or several small Sites may be located close to one another. In laying out a Forward Site, camouflaged parking areas for one or more aircraft clear of the landing and take-off area should be a consideration.

c. It is not planned to perform aircraft maintenance at a Forward Site. Should maintenance be required, the necessary equipment and personnel will be sent to the Forward Site and the maintenance performed or the AV-8A heli-lifted or surface transported to a suitable location.

203. (U) Facility

a. The minimum layout requirement for a Facility is a 600-foot by 72-foot takeoff strip, plus parking, maintenance, ordnance, and living areas. The strip should be interconnected with the parking and maintenance areas where up to 10 aircraft may be supported.

b. Pressure fueling is required. Fueling facilities, if not mobile, may be of the TAFDS type and will be adjacent to the parking area or a taxiway. Navigation and landing aids will be situated as dictated by the location of the Facility. The sophistication of the billeting and mess arrangements in the living area will be dependent upon the climate and estimated duration of the operation.

c. A Facility is capable of limited support of six to 10 aircraft. The Facility will be supported from a Sea Base or Main Base at some distance from the Facility. The major airfield support equipment to be located at a Facility is listed in Table D-2-1. The quantities are based on an assumed 100 percent availability of vehicles and equipment at all times, an availability to be achieved by immediate replacement from the Main Base of any out-of-commission vehicles or equipment

TABLE D-2-1. (U) MAJOR AIRFIELD SUPPORT EQUIPMENT FOR AN AV-8A FACILITY

Required	Desired	Description
0	1	FOD sweeper, MOD-T/90D type
0	1	Crash, fire, and rescue truck, MB-5 type
1	1	Amphibious, crash, fire, and rescue truck, M-116 type
0	1	Defueler truck, MC-1A M63 type
1	1	TAFDS or two refueling trucks
1	1	TACAN, TRN-29 type
1	1	Air traffic control, TRC-131A type
1	1	Generator Set, PU-344 type
1	1	Water distillation unit
1	1	Aircraft tow tractor

d. Safety criteria for the location and construction of expeditionary ammunition areas and magazines are contained in Ordnance Pamphlet 5, Ammunition Ashore (reference 4). In general, the ordnance storage and work area should be 1,000 feet from sources of high power radio frequency emissions. The ammunition storage areas should be 750 feet from the runway and taxiways, and at least 1,334 yards from the approach ends of the runways and 667 yards from the center of the approach lanes of the runway, and 800 yards from the nearest personnel and working areas. A demolition area must be another 800 yards removed. If suitable ammunition revetments are not constructed, cleared areas of approximately 3,600 square feet, 300 to 500 feet apart, may suffice for ammunition storage at a Facility. The requirements for storage compatability of the ammunition and dividing of assets to provide protective dispersal of ammunition must not be overlooked.

e. Aviation ammunition may be assembled at a Base and arrive at a Facility assembled but without fuzes attached. Napalm will be mixed at the Facility as required. Certain rocket configurations will be assembled at the Facility and some gun ammunition will be belted. The aviation ammunition expenditure from a Facility will depend on the tempo of operations and the support equipment provided. The major ordnance

related ground support equipment to be located at a Facility in order to support 6 or 10 aircraft is listed in Table D-2-2. The "minimum" corresponds to a daily aviation ammunition demand of 2 tons per aircraft, the "desired" corresponds to a daily demand of 4 tons per aircraft. Quantities are based on an assumed 100 percent availability of vehicles and equipment. This availability is to be achieved by the immediate replacement from the Main Base of any out-of-commission vehicle or equipment.

204. (U) Main Base

a. The minimum layout requirement for a Main Base is a 1,500-foot runway, and full airfield and aircraft maintenance support. The Marine Corps Expeditionary Airfield, less aircraft launch and recovery equipment, and limited to a 1,500-foot runway, meets the layout requirements for a Main Base.

b. Approximately 2,700 square feet of shop space will be required by the Intermediate Maintenance Activity to support a 20-plane squadron. The squadron will require approximately 109,800 square feet of maintenance and parking space to operate and support 20 aircraft. This area does not include billeting and administrative space.

c. The aviation ammunition areas must meet the safety criteria listed in paragraph 203. A bomb dump capable of handling, storage, administration, and surveillance of ammunition, ammunition components, and ammunition details, including the buildup of weapons for AV-8A employment, will be established at the base. It will be capable of a sustained output of 170 tons of ammunition daily and an output of 200 tons of ammunition for short periods, with a resupply factor of 3 to 5 days. The bomb dump will assemble ammunition without fuzes to be transported to a Facility. The bomb dump will require approximately 60,000 square feet divided into 16 revetments with berms.

TABLE D-2-2. (U) MAJOR ORDNANCE RELATED GROUND SUPPORT EQUIPMENT FOR AN AV-8A FACILITY (INCLUDES SQUADRON REQUIREMENTS)

AV-8A's 6 Minimum	AV-8A's 10 Desired	Description
2	3	Airborne armament trailers, A/M-32U type
5	10	Air launched weapons trailers, A/M-32K-4 type
1	3	Cranes, M-60 type
25	50	Stacking frames, MHU-64/E type
18	35	Cradles, MHU-63/E type
20	40	Cradles, MHU-65/E type
16	30	Multi-weapons support cradle, TER type
4	9	Shelter and handling system, A/E 99K-1 type
2	2	Forklifts, 6,000-pound capacity, rough terrain type
2	5	Air launched weapons loader, MJ-3 type
1	1	Generator set, 100 KW/60-cycle type
1	1	Air compressor, 250 cfm, 5,000 p.s.i. type
2	3	2½-ton trucks, M35A2 type, ordnance safety mod
1	1	'-ton truck with articulated crane
1	2	*10,000-gallon fuel bladders, TAFDS type
1	2	*Pump, TAFDS type
1	1	Aircraft tow tractor

* Required for Napalm mixing.

SECTION 3. PREPARATION AND INSTALLATION (U)

301. (U) General. This section describes the engineer requirements for the Main Base, Facility, and Forward Site. Engineering services required for the AV-8A as described in this annex include site preparation, shelter erection, fuel farm establishment, water supply demineralization, and utilities provision. It is expected that locations will be selected so as to reduce to a minimum the effort required to establish and maintain the various types of bases. To serve as a guide in determining the engineering effort required, five possible site selections have been described for each type of base ranging from an available airfield to that of single canopy trees with trunks less than 4 inches in diameter.

302. (U) Descriptions. A brief description of materials and equipments considered for utilization in the fullfillment of the engineer requirements are given below, to include items envisioned as being standard or developed for use in the near future.

a. SATS. Expeditionary Short Airfield for Tactical Support (see reference 5).

b. VATS. Expeditionary Verti-Lift Airfield for Tactical Support (see reference 6).

c. Bare Base Concept. Expeditionary Airfield Concept developed by the USAF utilizing abandoned airstrips.

d. AM2. Extruded Aluminum Alloy Matting in sheets of 2 feet by 12 feet by 1-3/4 inches, weighing 144 pounds per sheet. The matting is installed by teams of 13 men at the rate of 1,000 square feet per hour. This material is presently being used for the SATS runway.

e. AM6. Lightweight Extruded Aluminum Alloy Matting provided in sheets of 2 feet by 12 feet by 1 inch, weighing 81.6 pounds per sheet. This material is presently being introduced into the supply system and will replace the heavier AM2 matting in many applications. This material was tested in the United Kingdom during the Kestrel trials and found very satisfactory. It is laid at the same rate as AM2.

f. MOMAT. Fiberglass reinforced plastic mat manufactured from a plastic sheet with the patented name of STRATOGLAS. Each sheet is 12.2 feet by 48.5 feet by 1/10 inch thick, weighing 570 pounds per sheet. MOMAT weighs only 1 pound per square foot compared to 3.4 pounds per square foot for AM6. Installation is at the rate of 416 square

feet per man-hour. MOMAT is not suitable for landings or take-offs.

g. Tent, General Purpose, Medium. Used primarily for quartering personnel. This tent can also be used for a command post, mess hall, storage, sickbay, etc. The tent is intended for temperate and tropical climates; however, with the liner, it can be used effectively in cold climates. It is a rectangular hip roofed, pole supported tent with a center height of 10 feet. Floor dimensions are 32 feet 8 inches by 16 feet. Folded for shipment, the tent weighs 534 pounds and required 33 cubic feet of shipping space. Four men can erect the tent in 10 minutes.

h. Tent, Frame-type, Maintenance, Medium Light Metal. A medium size maintenance tent used mainly for repair of wheeled and tracked vehicles in temperate or cold climates. The tent is rectangular in shape with an arched top. The maximum height in the center is 14 feet, and the floor is 20 feet by 32 feet. Additional 8-foot intermediate sections can be added up to a maximum tent length of 64 feet. The basic tent weighs 1,582 pounds plus 475 pounds for the arctic liner. The 8-foot sections weigh 216 pounds. Shipping for the basic tent requires 52 cubic feet. The basic tent can be erected by eight men in approximately 4 hours.

i. Goodyear Lightweight Expandable Shelter. This shelter is a high expansion, rigid wall structure completely self-contained. When configured for shipment, each shelter measures 3 feet by 13 feet by 8 feet; three shelters are locked together for shipping. When expanded, each shelter measures 33 feet by 13 feet by 8 feet. The shelter including cots weighs 3,000 pounds. A complete description of this unit can be found in reference 6.

j. LUST (Latrine Facility, Bare Base) - Air Force lavatory, urinal, shower, and toilet. This is a self-contained transportable latrine facility containing 12 lavatories, a six-man shower, a six-man urinal, and six incinerator toilets designed to satisfy the daily requirements of 125 men. The unit measures 13 feet by 9 feet by 8 feet for shipment and weighs 6,900 pounds.

k. Single Incinerator Toilet. This toilet is identical to the toilet in the LUST system but is housed as a single unit. For shipping, the unit weighs 500 pounds and measures 50 inches by 40 inches by 44 inches.

l. Prefabricated Head. This unit is in the Marine Corps inventory. It is a portable four seater without

protective housing. Sewage holes must be dug to receive waste.

m. ATCO Storage Shelters. This shelter comes in sections. When erected, each section measures 40 feet by 10 feet by 20 feet 5 inches high. Several of these are connected together to form a structure 40 feet wide and any multiple of 10 feet long. For shipping, each section is folded to 21.5 feet by 10 feet by 26 inches, weighing 4,300 pounds. This building is in production as a standard item and is considered in the VATS Study.

n. ATCO Aircraft Shelter. This shelter is similar to the ATCO Shelter above except for its somewhat larger size. When erected, each section becomes 60 feet long, 8 feet wide, and 18 feet high. These sections when assembled to the desired length, are 60 feet wide, 28 feet high, and any multiple of 8 feet long. As few as six sections could be utilized to provide a suitable AV-8A hangar. Section weight is 4,300 pounds and measures 32 feet by 8 feet by 30 inches.

o. Modules (ATCO). These units weigh 2,000 pounds each and are used as workshops and office spaces in the SATS and VATS concepts. Erected, the units are 8 feet by 8 feet by 20 feet long; shipping size is 1 foot 7 inches by 8 feet by 20 feet.

p. Modules (SEMS) - Survival Equipment Maintenance Shelter. These units weigh 4,500 pounds and, when erected, they measures 8 feet by 20 feet by 9 feet. The shipping package is 2 feet by 8 feet by 20 inches.

q. Marine Field Galley. Consists of stoves, ovens, refrigerators, and cans for heating water to be used for washing mess gear. These units are used to prepare Class "A" and Class "B" meals.

r. Bare Base Kitchen Facility. Kitchen facility evaluated with the USAF Bare Base Concept. The unit is a complete kitchen and baking facility containing all the equipment to prepare Class "A" meals for 250 men, serve the meals in 1 hour, and sanitize all utensils. Heating elements are fuel fired, using readily available military fuels.

s. Class "A" Meal. A fully prepared full course hot meal.

t. Class "B" Meal. Canned and/or dehydrated meal requiring preparation including heating facilities. The meal includes meats, potatoes, vegetables, fruits, and desserts.

u. Class "C" Meal. Combat individual meals packed in cans. Individuals are furnished heat tabs to heat their own meals.

v. Eimco M103M64. Tractor, full tracked bulldozer, medium, low speed. The tractor is equipped with a 250 HP diesel engine, weighs 51,150 pounds, and occupies 1,680 cubic feet. The Eimco tractor will be replaced by the Terex 82-30 tractor.

w. Terex 82-30 Tractor. Tractor, full-tracked bulldozer, heavy, low speed. The tractor is equipped with a 225 HP diesel engine, weighs 54,335 pounds, and occupies approximately 1,060 cubic feet.

x. Case 1150 Tractor. Tractor, full tracked bulldozer, medium, with 4-in-1 bucket. The unit has a 105 HP diesel engine, weighs 17,500 pounds, and occupies 337 cubic feet.

y. Case 450 Tractor. Tractor, full tracked bulldozer, light; current allowance is special SEA. The unit has a 57 HP diesel engine, weighs 8,730 pounds, and occupies 315 cubic feet.

z. Case 580 Tractor. Loader, rubber tired, with backhoe. The unit has a 52 HP diesel engine, weighs 9,420 pounds, and occupies 2,002 cubic feet.

aa. MRS100 Tractor. Tractor, rubber tired, dozer. This unit is used to tow the 8-yard scraper, weighs 24,000 pounds, and occupies 1,354 cubic feet. The tractor can be sectionalized for helicopter transportation.

bb. 550 Grader. Diesel driven motorized grader. The unit weighs 26,900 pounds and occupies 1,543 cubic feet.

cc. 8-Yard Scraper. A towed unit used for cut and fill operation. Unit weight is 22,780 pounds and occupies 2,673 cubic feet.

dd. Sheepsfoot Roller. Tandem roller, water ballast used to compact below the surface. It is towed by the 450 tractor or a larger unit, weighs 6,225 pounds, and occupies 613 cubic feet.

ee. Grid Roller. Roller used to compact by layers for final compaction. It is towed with the 450 tractor, weighs 15,600 pounds, and occupies 768 cubic feet.

ff. Wobbly Wheel Roller. A 13-wheel, pneumatic earth ballast roller, weighing 4,120 pounds, and occupying 432 cubic feet.

gg. M60 Crane. Rubber tired, helicopter transportable when sectionalized. The unit has a 3,000-pound capacity, weighs 20,700 pounds, and occupies 1,347 cubic feet.

hh. 6,000-Pound Forklift. An MIL Standard, rubber tired, rough terrain, 6,000-pound capacity forklift, weighing 17,900 pounds, and occupying 1,100 cubic feet.

ii. 3,000-Pound Forklift. A Marine Corps forklift with a 3,000-pound capacity. It is a rubber tired, rough terrain unit, weighing 3,500 pounds. It will be replaced by the 4,000-pound forklift when development and procurement is completed.

jj. 4,000-Pound Forklift. A Marine Corps helicopter transportable forklift with a 4,000-pound capacity. It is anticipated that the forklift will be a rubber tired, rough terrain unit weighing approximately 4,500 pounds.

kk. Lightweight Road Grader. To be developed with the capability of being transported by helicopter.

ll. Lightweight Scraper. To be developed with the capability of being transported by helicopter.

mm. Lightweight Dump Truck. To be developed with the capability of being transported by helicopter.

303. (U) Surface Limitations. The following general conditions apply in determining preparation requirements (reference 1):

a. When the aircraft is operating on the ground or at less than 50 feet above the ground and the forward speed is below 50 knots, the operating area must be free of any loose hard objects. When loose objects are present, aircraft take-off and landing speeds must be 50 knots or greater.

b. On consolidated turf which is free of stones, the touchdown speed may be reduced to 25 knots. Subsequent landings may not be possible at the same spot.

c. Rolling short take-offs or landings may lift the surface of old, cracked tarmac surfaces.

d. Unprepared sites must have a California Bearing Ratio (CBR) value of 8 to 10 percent at a depth of 3 inches and below for repeated operation.

e. Local undulations on unprepared sites should not exceed 6 inches (peak to trough) with a minimum half pitch of 50 feet, or 12 inches (peak to trough) with a minimum half pitch of 100 feet. There should not be more than two peaks to the same wave length.

f. Lateral gradients, and overall gradients, should not exceed a slope of 1 in 40 (about 1½ degrees) for Facilities and not more than 1 in 12 (about 5 degrees) for Forward Sites.

g. On surfaces with a CBR of 10 percent or greater, the aircraft will tolerate smooth random bumps. No sharp edges or pointed obstructions can be tolerated; in touchdown areas, bumps up to 1½ inches can be tolerated. Other areas can have 2½-inch bumps for maneuvering below 7 knots and taxiing into a straight line up to 15 knots.

h. When the aircraft is moved over unprepared surfaces, the tire ruts must not exceed 3½ inches.

i. Prepared pads must not slope more than 1½ degrees in any direction.

j. Prepared pads must be kept free of loose debris.

304. (U) Surface Preparation

a. Main Base. Described below are five representative surface conditions which could exist at selected locations. These are intended as a guide for estimating the engineer requirements for the Main Base.

(1) Available Airfield. Engineer requirements are considered to be zero at an existing airfield. Suitable parking areas will generally be available and a resupply zone will have been established.

(2) Abandoned or Damaged Airstrip. Most likely an abandoned airstrip surface will have deteriorated somewhat due to weathering. On-site inspection would be required for complete analysis; however, it can be reasonably assumed that necessary patching and a general sweepdown can be accomplished by hand within a day. Parking and resupply areas will generally be available.

TABLE D-3-1. (U) QUANTITY OF EQUIPMENT/PERSONNEL FOR AV-8A MAIN BASE RUNWAY FLAT OPEN GRASSLAND

ITEM	1 DAY	2 DAYS	3 DAYS
Eimco M103M64	4	3	2
8-Yard Scraper	3	2	1
550 Grader	3	2	1
Sheepsfoot Roller	2	1	1
Grid Roller	2	1	1
MRS100 Tractor	3	2	1
Men	78	68	63

TABLE D-3-2. (U) QUANTITY OF EQUIPMENT/PERSONNEL FOR AV-8A MAIN BASE RUNWAY ROUGH OPEN TERRAIN

ITEM	1 DAY	2 DAYS	3 DAYS	4 DAYS
Eimco M103M64	16	8	6	4
8-Yard Scraper	12	6	4	3
MRS100 Tractor	12	6	4	3
550 Grader	5	3	2	2
Sheepsfoot Roller	6	3	2	2
Grid Roller	3	1	1	1
580 Tractor	2	2	1	1
Forklift, 6,000-Pound	4	4	3	3
Men	140	101	87	83

(3) Flat Open Grassland. It is unlikely that an area 1,500 feet long with open approaches meeting the criteria of paragraph 303 will exist. Should such conditions exist, runways can be installed without prior preparation. For this section, however, an estimate for equipment is based on 10 percent of the 13,000-square yard strip requiring the excavating of 500 cubic yards of earth. This 10 percent area is an arbitrary figure chosen for example. The equipment listed in Table D-3-1 includes that required for cut and fill, spreading, compacting, and grading. Covering the surface could be accomplished with materials such as AM2 or AM6. Operating four teams at a time, the strip can be laid in 24 hours. An area of 16,700 square feet may be covered with MOMAT to provide a suitable maintenance area.

(4) Rough Open Terrain, Small Brush Cover. This type of terrain would consist of small knolls, erosion gullies, and low profile scrubs. The first step in preparation would be the clearing and grubbing operation. After the initial clearing has been accomplished, the cut and fill operations begin, followed by the compactions and grading. Time and equipment breakdown for the 12,000-square yard runway is as shown in Table D-3-2. The runway will be covered in the manner described under paragraph 304a(3). The parking and maintenance area should be covered with MOMAT. AM2 or AM6 would also be satisfactory for this area but would increase the logistic weight factor 3.4 to 6 times. Approximately 12,200 square yards should be covered for the parking and maintenance areas.

(5) Single Canopy, Tree Trunks Less Than 4 Inches in Diameter. This condition describes the minimum type of wooded area. Clearing would require more effort than in paragraph 304a(4), but the operation would still be considered grubbing. These trees would normally be bulldozed down and pushed off to the side. From this point on, the operation would be similar to that of paragraph 304a(4). Equipment and man-day estimate for various number of days is as listed in Table D-3-3.

b. Facility. Described below are the five typical sites considered for the Facility. Estimates of engineering effort are based on a 600 by 72-foot runway.

(1) Available Airfield. Engineer requirements are considered to be zero at an existing airfield. Suitable parking areas will generally be available and a resupply zone will have been established.

TABLE D-3-3. (U) QUANTITY OF EQUIPMENT/PERSONNEL FOR AV-8A MAIN BASE RUNWAY SINGLE CANOPY

ITEM	1 DAY	2 DAYS	3 DAYS	4 DAYS
Eimco M103M64	20	10	7	5
8-Yard Scraper	16	8	6	4
MRS100 Tractor	16	8	6	4
550 Grader	5	3	2	2
Sheepsfoot Roller	6	3	2	2
Grid Roller	2	1	1	1
580 Tractor	2	2	1	1
Forklift, 6,000-Pound	4	4	3	3
Men	158	121	94	85

TABLE D-3-4. (U) QUANTITY OF EQUIPMENT/PERSONNEL FOR AV-8A FACILITY RUNWAY ROUGH OPEN TERRAIN

ITEM	1 DAY	2 DAYS	3 DAYS
450 Tractor	6	4	2
580 Tractor	4	2	2
Lightweight Scraper	4	3	2
Lightweight Road Grader	2	2	1
Sheepsfoot Roller	2	1	1
Lightweight Dump Truck	6	4	3
Grid Roller	1	1	1
Forklift, 4,000-Pound	4	4	4
Men	85	76	72

(2) Abandoned or Damaged Airstrip or Roadway. It is considered feasible to land the AV-8A on any of these surfaces. On-site inspection, patching, and cleanup of loose objects should be accomplished in less than a day. Parking should pose no problem in this area.

(3) Flat Open Grassland. Covering the surface could be accomplished with materials such as AM2 or AM6. The runway could be prepared in 12 hours utilizing four crews operating 6 hours each. Suitable parking areas on the grass could be available. Turnaround maintenance is expected to take place in the parking area, which need not be covered with matting if the surface meets the criteria in paragraph 303.

(4) Rough Open Terrain, Small Brush Cover. This type of terrain has been described in 304a(4). Operation for preparing the Facility should be identical to that of the Main Base except smaller air transportable equipment may be utilized. Time and equipment breakdown for the 4,800-square yard runway is as listed in Table D-3-4. A parking area of 5,000 square yards, covered with MOMAT, could be completed in less than 8 hours.

(5) Single Canopy, Tree Trunks Less Than 4-Inch Diameter. Preparation of this type area is described in 304a(5). The operation should be identical to that of the Main Base, except helicopter transportable equipment may be utilized. Table D-3-5 lists the time and equipment breakdown for the 4,800-square yard runway.

c. Forward Sites. The five selected sites are described below.

(1) Available Airfield. These areas are considered usable without an engineering effort.

(2) Available or Damaged Airfield or Roadway. When either of these areas exist, only a small crew would be required to clear the area of loose objects prior to AV-8A operations.

(3) Flat Open Grassland. A flat 75 by 75 foot area is required for surfacing. These sites should be readily available without site preparation. AM2 or AM6 could be used for this site. These materials will cover a 72 by 72 foot area. The subgrade sealing membrane will expand the pad to 75 by 75 feet. Any of these surfaces could be installed in less than 8 hours. When additional parking area is required, the area could be covered with AM2, AM6, or MOMAT. It may be

TABLE D-3-5. (U) QUANTITY OF EQUIPMENT/PERSONNEL FOR AV-8A FACILITY RUNWAY SINGLE CANOPY

ITEM	1 DAY	2 DAYS	3 DAYS
450 Tractor	10	7	4
580 Tractor	4	4	2
Lightweight Scraper	4	3	2
Lightweight Road Grader	2	2	1
Sheepsfoot Roller	2	1	1
Lightweight Dump Truck	6	4	3
Grid Roller	1	1	1
Forklift, 4,000-Pound	4	4	4
Men	87	82	72

TABLE D-3-6. (U) QUANTITY OF EQUIPMENT/PERSONNEL FOR AV-8A FORWARD SITE SINGLE CANOPY TREES

	PAD ONLY		PAD AND PARKING AREA	
ITEM	1 DAY	2 DAYS	1 DAY	2 DAYS
450 Tractor	2	1	4	2
Lightweight Road Grader	2	1	2	1
Sheepsfoot Roller	1	1	1	1
Wobbly Wheel Roller	1	1	1	1
Men	22	19	25	21

more advantageous when using AM2 or AM6 to construct a second landing pad in lieu of a parking area.

(4) Rough Open Terrain, Small Brush Cover. When the best site selection is of this nature, several methods are available for clearing the site and parking area. One method would be by hand; however, a more rapid method would be with a 450 tractor and a roller. With this equipment, the site should be ready in one day. Pad construction should be similar to that of paragraph 304g(4).

(5) Single Canopy, Tree Trunks Less Than 4 Inches in Diameter. The preparation will be similar to that of the Facility, utilizing helicopter transportable equipment. Table D-3-6 lists the time and equipment required.

305. (U) Shelters

a. Main Base. Expeditionary shelters will be provided at the Main Base for storage, offices, maintenance, billeting, and life support. Two alternatives are presented to fulfill these requirements. One method is with the standard military tents. The other alternative is utilizing the shelters and life support equipment found in the SATS, VATS, and the USAF Bare Base concepts. The first method provides the lesser logistic requirement, and the trade-off consideration for the latter is the improved morale and physical well-being of the personnel.

(1) Storage. Storage space at the Main Base will be required to support the Main Base, Facilities, and Forward Sites. Five thousand square feet of covered storage is planned; this can be accomplished with 10 medium general purpose tents or two ATCO storage shelters, each erected 60 feet long.

(2) Offices/Workshops. Five individual offices or workshops are planned. These offices or workshops may be medium general purpose tents; however, modules are much more satisfactory when power machinery is utilized in the workshop area.

(3) Maintenance. Standard tents large enough to contain the AV-8A do not exist in inventory. The frame type maintenance tent would provide suitable space for some repairs. The ATCO hangar would provide the necessary space for covered maintenance of the AV-8A. When this hangar is used, suitable space would be available to house most of the workshops required utilizing attachable lean-tos.

(4) Billeting. Quarters are required for 400 to 500 men. Utilizing the medium general purpose tents or the Goodyear expandable shelter, 40 to 50 units would be required.

(5) Life Support. Life support will include sickbay, galley, heads, and protective trenches.

(a) Sickbay. This area will be established to provide first aid. More serious cases will be air lifted to a field hospital. The sickbay should be established with a minimum of two general purpose tents or two Goodyear expandable shelters.

(b) Galley. The galley facilities will be determined by the type meals that will be provided at the Main Base. Normally, either a Class "A" or Class "B" meal will be provided. The Class "A" meal requires a field galley with refrigeration capability. The Class "B" meal requires a field galley less refrigeration units.

(c) Heads. The minimum sanitary conditions can be provided with the Marine Corps prefabricated head and a water supply. For extended operations, a unit such as the USAF LUST system will be more satisfactory. The Marine Corps will begin evaluation of similar units in FY 73.

(d) Protective Trenches. The urgency of these trenches depends on the hostility of the area. Once the airfield is complete, the Case 580 tractor could be utilized to provide these trenches.

b. Facility. The tent concept is considered feasible for this area.

(1) Storage. Two general purpose tents should provide sufficient storage at the Facility. They will provide 1,024 square feet of storage.

(2) Billeting. Ten general purpose tents are required to house personnel at the Facility.

(3) Head. The Marine Corps prefabricated head provides adequate service. Four of these units will be required.

(4) Sickbay. One medium general purpose tent would provide the required sickbay area.

(5) Galley. Class "C" rations may be utilized at the Facility. Should Class "A" or "B" meals be desired,

the same units as described for the Main Base would be required to prepare the meals at the Facility.

c. Forward Site. Requirements may not exist at the Forward Site for shelters. Should individuals be required to spend the night, shelter halves or tents could be utilized.

306. (U) Fuel Farm

a. Main Base. The Marine Corps employs the Tactical Airfield Fuel Dispensing System (TAFDS) for refueling aircraft at expeditionary fields. The system includes pumps, filter separators, hoses, couplings, and collapsible storage tanks. The present TAFDS refuels at the rate of 350 gallons per minute and utilizes 10,000-gallon tanks. This system is presently undergoing modifications to refuel at the rate of 600 gallons per minute at 50 to 60 psi, utilizing 20,000-gallon storage tanks. Six tanks will support one squadron of AV-8A's.

b. Facility. The storage capacity should be 30,000 gallons and requires pumps, filters, hoses, and tanks similar to the TAFDS. This can be a stationary system or in wheeled tankers. Fuel delivery to the Facility will be by truck or by helicopter carried bladders.

c. Forward Site. Normally, no requirement exists for refueling at the Forward Site. Fuel trucks or helicopter expedient refueling system (HERS) may be utilized if the tactical situation requires refueling.

307. (U) Water Supply

a. Main Base. Water is required at the Main Base for both personnel and the aircraft. Total daily water required at the Main Base is estimated at 32,000 gallons, of which 3,600 gallons are demineralized water for the AV-8A engine. Water may be shipped in bladders or provided from a well on site. Demineralized water can be provided to the required specifications utilizing the standard trailer mounted distiller in the Marine Corps inventory. Presently, there are no suitable storage containers in the Marine Corps inventory for demineralized water.

b. Facility. The demineralized water supply for the Facility will probably be transported by wheeled tanker or helicopter transportable bladder from the Main Base if adequate water is not available.

c. Forward Site. Presently, no provision is being made to supply water at the Forward Site.

308. (U) Electrical Requirements

a. Main Base. The electrical requirements for the Main Base are estimated at 5,448 KVA. The standard expeditionary airfield utilizes an 8,500 KVA power supply. This unit would provide ample power for the Main Base.

b. Facility. A 100 KW self-contained unit plus organic T/E generators should be able to provide the required power at the Facility.

c. Forward Site. No power requirement is anticipated at the Forward Site.

309. (U) Ordnance Storage. The criteria for ordnance storage at AV-8A bases are governed by the requirements imposed in Ordnance Pamphlet 5 (reference 4). When revetments are utilized, they will be constructed 60 feet by 60 feet with walls 3 feet wide at the top and 12 to 15 feet high. Without revetments, open storage must be in stacks of less than 20 tons separated by 300 to 500 feet. Location of the storage area must be 1,000 feet from sources of high power radio frequency emissions, 750 feet from the runway and taxiway, 1,334 yards from the approach ends of the runway and 667 yards from the center of the approach lanes of the runway, and 800 yards from the nearest personnel or working area. When trees or vegetation exist in the storage area, only those in the actual storage space will be removed. If required because of soft soil problems, the revetments will be stabilized and matting provided on roadways connecting the storage to the ordnance loading area.

a. Main Base. The ordnance storage area will cover an area of 450,000 square feet. In this area, 16 revetments will be constructed. Each revetment will require one day to construct, utilizing three scrapers and tractors. A demolition area will require an additional revetment 800 yards from the storage area.

b. Facility. Because of the engineer effort required for revetments, only open storage will be considered at the Facility.

c. Forward Site. Normally, there will be no ordnance storage provided at the Forward Site. Open storage may be utilized if the tactical situation requires.

SECTION 4. SECURITY (U)

401. (U) General. Security of a Main Base, a Facility and a Forward Site is not considered to be essentially different from any fixed or semi-fixed installation; however, there are factors which should be considered by the commander prior to displacement of aviation ashore or forward. Sea basing poses no security problems peculiar to AV-8A operations; therefore, only land basing will be addressed.

402. (U) Main Base. The establishment of security for a Main Base is essentially no different from that of a standard airfield. Physical security may be provided by a provisional ground defense force or by an infantry unit assigned from the landing force. The size of the Main Base will normally permit dispersal of aircraft.

403. (U) Facility. The need for physical security at a Facility will increase somewhat from that of a Main Base because of the proximity of the Facility to the enemy under envisioned concepts of employment. A Facility may not have space available for aircraft dispersal. In these cases, plans must be made for aircraft fly-away to prevent damage or destruction of the planes if the Facility is threatened by enemy fires. Physical security will be provided by a provisional defense force or an infantry element of the landing force, as determined by the landing force commander. Maximum use should be made of camouflage. The landing force commander will be required to weigh the advantages of establishing a Facility against the disadvantages of committing infantry to security functions.

404. (U) Forward Site. The nature of a Forward Site and its location in relation to "frontline" units in presently envisioned concepts of employment dictate that 24-hour physical security be provided. Consideration must be given to AV-8A's VTOL signature disclosing the location of relatively unprepared sites. The Forward Site will usually be moved periodically which will provide a measure of security for the aircraft. Maximum use of camouflage at the Forward Site should be practiced, and aircraft should be removed to a Main Base or a Facility during the hours of darkness or reduced visibility to prevent damage or destruction by enemy fires.

(U) REFERENCES

1. U.K. Ministry of Technology, HARRIER G.R. Mk 1 Aircrew Manual, Air Publication 101B-[illegible]-15, Apr 69 (For Official Use Only).

2. Tripartite Kestrel Evaluation Squadron, Kestrel Evaluation Trials, KES/C4/AIR, Mar 66 (For Official Use Only).

3. Hawker Siddeley Aviation Limited, HARRIER G.R. Mk 50 for U.S. Marine Corps, Aircraft Specification No. 271.F, 7 Aug 69 (For Official Use Only).

4. U.S. Navy, Ordnance Pamphlet 5, Ammunition Ashore, 9 Aug 57 (Unclassified).

5. Naval Air Systems Command, Logistics Analysis - Initial Staging Area to Field Installation - Short Airfield for Tactical Support, NAVAIR 51-[illegible]-1, 1 Jan 6[illegible] (Unclassified).

6. Naval Air Engineering Center, Verti-Lift Airfield for Tactical Support (VATS) Configuration Report, NAEC-ENG-7672, 5 Nov 70 (Unclassified).

ANNEX E - COMMAND AND CONTROL (U)

SECTION 1. INTRODUCTION (U)

101. (U) General. This annex considers the command and control procedures to be used when employing the AV-8A as a function of the basing concept.

102. (U) Background.

a. Introduction of the AV-8A with its V/STOL capability raises the question of how to integrate this aircraft with existing command and control procedures so as to fully exploit its unique characteristics and to increase the responsiveness of air support to ground forces.

b. The air command and control systems, both Navy and Marine Corps, appear adequate as presently constituted to accommodate employment of the aircraft. There are, however, specific aspects of command and control procedures which must be carefully examined to determine how best to adapt them to various basing postures.

c. Current doctrinal procedures for command and control as set forth in NWP's and FMFM's will apply where applicable.

d. The procedures developed in this annex will be subjected to operational testing during the conduct of an amphibious exercise and will be refined or verified.

103. (U) Scope/Methodology

a. In order to provide a basis for integration of the AV-8A into the command and control system, the existing agencies and their functions will be examined.

b. Integration of the AV-8A into the system will be presented by an examination of the procedures utilized to provide command and control during employment from Sea Bases/ Platforms, Forward Sites, Facilities, and Main Bases.

SECTION 2. COMMAND AND CONTROL SYSTEMS (U)

201. (U) Navy Air Control Agencies. Existing agencies for air control afloat are outlined below:

a. During the afloat phase of amphibious operations, the Commander Amphibious Task Force (CATF) delegates the authority to control aircraft to a member of his staff called the Tactical Air Officer (TAO). The TAO is normally the commanding officer of a Tactical Air Control Squadron (TACRON), the Navy organization which is designed to control air operations for an amphibious task force. The TAO controls air operations through three agencies--the Tactical Air Control Center (TACC (afloat)), the Helicopter Direction Center (HDC), and the Tactical Air Direction Center (TADC (afloat)).

b. The TACC is the senior agency within the Navy air control system. It is normally located aboard the CATF flagship within the Supporting Arms Coordination Center (SACC) and near the flagship Combat Information Center (CIC). This arrangement simplifies the SACC's job of coordinating all supporting arms and allows the TACC to use the CIC's facilities to control air defense operations. The TACC coordinates air operations among the subordinate control agencies and directly controls air operations within the Amphibious Objective Area (AOA), except helicopter ship-to-shore movement. The TACC delegates control of helicopter ship-to-shore operations to an HDC.

c. The HDC is normally located on the Transport Group/Unit Commander's flagship so that it can respond to the Commander Landing Force's (CLF) plans and directions in the helicopter ship-to-shore movement during the assault phase. This agency receives all mission requests for helicopter ship-to-shore movement and assigns specific aircraft to perform these missions. The HDC must coordinate all helicopter operations with the TACC to insure they do not interfere with other air operations, and the TACC must coordinate all air operations with the SACC so they do not interfere with other supporting arms.

d. The third control agency in the Navy air control system is the Tactical Air Direction Center (TADC). The TADC is similar to the TACC except that its control authority within the AOA is subordinate to the TACC and is limited, either in time or space. A TADC is formed to control air operations under three conditions:

(1) When an advance force enters the AOA to conduct preassault operations before the CATF arrives, the

Advance Force Commander will control air operations from his flagship through a TADC.

(2) When CATF divides the AOA into sectors, he will delegate the authority to control air operations in each sector to an Attack Group Commander.

(3) As the landing force moves ashore, the CATF normally divides the AOA into landward and seaward sectors and passes control of air operations in the landward sector to the CLF in increments as the landing force phases its air control agencies ashore.

202. (U) Marine Air Command and Control Agencies. Existing agencies within the Marine Air Command and Control System (MACCS) for control of air support during the assault phase of an amphibious operation and subsequent operations ashore are outlined below:

a. The Tactical Air Control Party (TACP) is the air control agency organic to the ground combat element of the landing force. The mission of the TACP is to establish and maintain communications and liaison between the unit in which it functions and appropriate air control agencies for the request, coordination, and control of close air support, and to advise the commander on the employment of air support. The battalion TACP is composed of an Air Liaison Officer (ALO) and two Forward Air Controllers (FAC's). The regimental TACP consists of one ALO, and the division TACP consists of two ALO's. Each TACP has the communication personnel and equipment required for its tasks. For the purpose of coordination of air support with other supporting arms, the TACP's are collocated with respective level Fire Support Coordination Centers (FSCC's). The ALO of each TACP is functionally the Air Officer of the FSCC.

b. The Forward Air Controller is an aviation officer member of the TACP who, from a forward position, or in an observation aircraft, controls aircraft engaged in close air support missions. He may request and control airstrikes on preplanned targets or targets of opportunity.

c. The Direct Air Support Center (DASC) is the principal air control agency subordinate to the TACC/TADC. It is organized and equipped specifically for the purpose of control and direction of close air support and assault support operations. The primary function of the DASC is to provide a fast reaction capability to requests for tactical air support. The TACC/TADC allocates sorties, along with

the necessary control authority, to the DASC to satisfy requests for tactical air support.

d. The Tactical Air Command Center (TACC) is the senior air control agency of the landing force. It is capable of directing, controlling, and coordinating all air operations in the objective area.

e. The Tactical Air Direction Center (TADC) is an air control agency subordinate to the TACC (afloat/ashore). It is the agency through which the CLF exercises direction, control, and coordination of air operations within his assigned sector of responsibility. When control of air operations is passed from CATF to CLF, the TADC becomes the TACC. Whenever air operations are of such magnitude or cover areas of such size that it becomes impractical to direct all air operations from a single TACC, one or more TADC's may be established to direct, control, and coordinate certain specific air operations or air operations within designated sectors.

f. The Marine Air Traffic Control Unit (MATCU) provides expeditionary terminal control facilities for aircraft take-offs and landings and is specifically organized and equipped to perform this service. The MATCU's are organic to each Marine Aircraft Group (MAG).

g. In addition to the above, two other elements of the MACCS remain to be discussed. They are the Tactical Air Operations Center (TAOC) and the Air Support Radar Teams (ASRT's). The TAOC is the subordinate to the TACC/TADC. Its primary mission is to detect, identify, and control the intercept of hostile aircraft and missiles. It also provides navigational assistance to friendly aircraft in the accomplishment of support missions. The ASRT is an air support control agency subordinate to the DASC. Its primary mission is to provide day/night precision radar tracking and positioning of strike aircraft in all-weather and visibility conditions for medium and high altitude bombing. Both agencies are primarily involved with the control of aircraft once they are airborne as opposed to land/launch control functions. Since it has been previously noted that the AV-8A will operate in the same manner as other fixed-wing aircraft once airborne, further discussion of these agencies is not necessary.

UNCLASSIFIED

SECTION 3. COMMAND CONTROL DURING EMPLOYMENT OF THE AV-8A (U)

301. (U) General. As presented in Annex D, AV-8A operations in support of the landing force will occur in three distinct phases--Phase One features operations from Sea Bases; Phase Two features emplacement of a Facility; and Phase Three includes establishment of a Main Base. This section will discuss the command and control procedures employed while conducting operations from Sea Bases/Platforms, Forward Sites, Facilities, and Main Bases as outlined in the basic concept.

302. (U) Seabases/Platforms.

a. Through the combined facilities of the SACC, TACC, and/or TADC, the CATF has the capability to control and integrate the supporting arms of the task force. The elements of the SACC provide the means for coordinating and directing supporting arms into target areas. The TACC or TADC have the facilities for controlling and directing all air support. Each Sea Base and Sea Platform provides UHF communications for launch and recovery of aircraft. It is into this framework that the AV-8A command and control requirements will be integrated.

b. When a mission request is submitted to the TACC on the Tactical Air Request (TAR) net, the TACC evaluates the request and coordinates area clearance with the SACC. Upon approval of the mission, the TACC alerts the AV-8A element selected for the mission by means of internal ship's radio, the Helicopter Command net, the Tactical Air Traffic Control net (TATC), or Air Coordination net, which link all Sea Bases and Platforms with the TACC. Detailed mission brief may be passed, or the AV-8A may simply be directed to launch for further brief, once airborne, on an assigned UHF frequency.

c. When clear of the immediate launch site, the AV-8A will switch to the assigned frequency for further instruction and/or mission brief. Once communication is established with the TACC, air control of the AV-8A will be identical to that of any other fixed-wing attack aircraft. Upon completion of the assigned mission, the AV-8A will check back through the TACC and control will be passed back to the appropriate Sea Base or Sea Platform for recovery.

d. During the afloat phase, the amphibious task force relies upon CVA and CVS elements for antiair and long-range surface defense. Introduction of the AV-8A into the amphibious force inventory provides the force commander with a new and flexible defensive weapon. AV-8A's located aboard Sea Platforms and Sea Bases may be postured in an on-call status.

prepared to attack targets of opportunity or to provide additional counterair or surface defense forces. Command and control communications are available to effect employment in this manner.

303. (U) Forward Sites.

a. Since the TACP is landed concurrently with a battalion or regimental command post, and is collocated with the FSCC, it is possible that employment of the AV-8A early in the landing phase could be accomplished by locating the Forward Site close to the TACP/FSCC's. This employment is expected to be dependent upon the ability to utilize possible existing roads, abandoned airfields, or suitably stable fields/areas. The time frame addressed is very early in the landing/assault phase and only limited forces and engineer effort would be available for site preparation or security. The TACP/FSCC at the battalion/regimental levels possess the requisite communications for contact with the TACC/TADC and SACC, or the DASC when it is ashore, for the purpose of area and mission clearance. Communication with the Forward Site may be accomplished by UHF, HF, FM, or a land line. Land/launch communications could be accomplished using UHF and FM between the TACP or DASC and the AV-8A. The line-of-site limitations of UHF and FM communications from ground-to-ground sites must be recognized.

b. In certain situations, a Forward Site may serve to place the AV-8A in the optimum location for immediate response to the ground commanders' air support requirements. The TACC/TADC or DASC, acting upon order of the CATF/CLF, may allocate AV-8A's to Forward Sites to function in support of a ground unit. The supported ground unit could be authorized to launch the AV-8A without experiencing even the limited processing delay occasioned by the MACCS. Launch of the AV-8A through the use of organic TACP communications would be directly responsive to the particular ground commander. The TACC/TADC or DASC, as appropriate, will monitor the request, and silence will indicate approval of the launch. The DASC or TACC/TADC would retain the option of diverting aircraft so assigned either prior to or after launch. This option permits massing of aircraft assets or divert of sorties to more critical missions. In those instances where communication limitations preclude the TACC/TADC or DASC from monitoring requests, a determination must be made, prior to allocation of the AV-8A to a Forward Site, as to whether launch can be directed by the TACP without prior approval. If concurrence is required prior to launch, the communication relay requirement may negate the advantage hoped for in response time.

c. The DASC moves ashore as soon as the tactical situation permits and possesses the requisite communication equipment for control and coordination of the close air support for the landing force. Employment of the AV-8A could be accomplished by locating the Forward Site close to the DASC. Communications with the Forward Site may be accomplished by UHF, HF, FM, or a land line. Land/launch communications between the AV-8A and the DASC could be accomplished using UHF or FM.

d. The procedures outlined for the DASC are equally applicable in considering the AV-8A with the TACC/TADC.

304. (U) Facility and Main Base.

a. During Phase Two, the AV-8A will operate from a Facility, which is a small airfield with the capability to provide limited support to aircraft ashore. Communication between agencies of the MACCS and the Facility may be accomplished by UHF, HF, FM, or land line. The Facility is fully integrated into the MACCS, and command and control of the AV-8A is identical to that of any other fixed-wing aircraft. Land/launch communications will be supported by MATCU.

b. Establishment of a Main Base will provide complete support of the AV-8A ashore. The Main Base is fully integrated into the MACCS, and command and control is identical to that of the Facility. Land/launch communications will be supported by MATCU.

[redacted]

ANNEX F - LOGISTIC SUPPORT (U)

SECTION 1. LOGISTIC REQUIREMENTS (U)

101. (U) General. This annex discusses concepts for logistic support of AV-8A operations from the bases defined in Annex D. The following categories of logistic support are addressed:

a. Maintenance.

b. Transportation.

c. Stockage.

d. Deployment.

102. (U) Criteria. The logistic support system for the AV-8A should allow the aircraft to achieve its maximum combat effectiveness in the most economic fashion. Specifically, the most desirable logistic support system should:

a. Meet day-to-day requirements in a routine manner.

b. Be readily and rapidly expandable to meet peak requirements.

c. Provide reliable support in the combat environment.

d. Be economical in operation.

e. Be readily deployable with the landing force.

f. Have no adverse effect on landing force operations.

g. Have no adverse effect on AV-8A effectiveness.

h. Be compatible with Marine Corps logistic doctrine.

103. (U) Maintenance. The maintenance concept must establish a balance between self-sufficiency at each type of base and economy of centralized support. The maintenance requirements for each type of base, developed in Annex D, provide the capability for each base to perform maintenance commensurate with its function. Should the need arise for unscheduled maintenance exceeding the capability of a Sea Platform, Facility, or Forward Site, this need can be met by flying the aircraft to a Main Base or Sea Base (if the aircraft is flyable); bringing the necessary personnel and equipment to the [redacted] Platform, Facility, or Forward Site; or lifting the

This material contains information affecting the National Defense of the United States within the meaning of espionage laws, title 18, U.S.C. sections 793 and 794. Its transmission or the revelation of its contents in manner to an unauthorized person is prohibited by law.

CLASSIFIED BY CMC (AX)
SUBJECT TO GENERAL DECLASSIFICATION SCHEDULE OF EXECUTIVE ORDER 11652
AUTOMATICALLY DOWNGRADED AT TWO YEAR INTERVALS
NOT AUTOMATICALLY DECLASSIFIED. DECLASSIFY ON: DECEMBER 1979

[redacted]

[redacted]

aircraft to a Main Base or Sea Base by heavy lift helicopter. The following capabilities are envisioned at each type of base:

a. Sea Base. A Sea Base provides organizational (OMA) and intermediate (IMA) maintenance activity. If shipboard limitations preclude a full IMA capability, additional spares must be provided for those items which cannot be repaired. Support must be provided for aircraft operating from Sea Platforms as well as from the Sea Base.

b. Sea Platform. A Sea Platform may or may not be capable of turning around AV-8A missions. If a turnaround capability is required, the following support is necessary:

(1) Capability to perform turnaround inspection.

(2) Pressure refueling.

(3) Demineralized water replenishment.

(4) Ordnance loading.

(5) If possible, capability to perform minor repairs of a recurring nature.

c. Main Base. A Main Base provides OMA and IMA. The most economical manner of providing this capability ashore in an amphibious operation is to phase ashore the personnel and equipment from a Sea Base, augmented as necessary to establish the Main Base. The Main Base must be capable of supporting subsidiary Facilities and Forward Sites.

d. Facility. A Facility provides limited OMA maintenance for the AV-8A. For economy of operation, it is desirable that aircraft operating from a Facility be retained there for several days, except during tactical situations in which security at night cannot be provided. The following support is needed at a Facility:

(1) Capability to perform daily and turnaround inspections and servicing.

(2) Pressure refueling.

(3) Demineralized water replenishment.

(4) Liquid oxygen (LOX) replenishment.

(5) Ordnance loading.

WARNING

This material contains information affecting the National Defense of the United States within the meaning of espionage laws, title 18, U. S. C. sections 793 and 794. Its transmission or the revelation of its contents in manner to an unauthorized person is prohibited by law.

CLASSIFIED BY CMC (AX)
SUBJECT TO GENERAL DECLASSIFICATION
SCHEDULE OF EXECUTIVE ORDER 11652
AUTOMATICALLY DOWNGRADED AT TWO YEAR INTERVALS
DECLASSIFIED ON 31 DECEMBER 1979

[redacted]

(6) Capability to perform on-aircraft repairs of a recurring nature such as tire change, replacement of line replaceable units, system checks, adjustments, and minor repairs.

e. Forward Site. A Forward Site provides the mirimum support necessary. Although the AV-8A can remain on ground alert with no external support, it may be desirable in certain situations to assign maintenance personnel to Forward Site.

104. (U) Transportation. Transportation requirements in support of the AV-8A will vary depending on mission requirements, base locations and accessibility, weather, and terrain. Since these requirements will not be constant, it is not desirable to establish a dedicated transportation system in support of the AV-8A (exclusive of squadron T/E). Transportation assets will be allocated by the landing force commander on the basis of overall landing force logistic capabilities and requirements. The discussion below established typical transportation requirements for replenishment, personnel, and other materiel.

a. Replenishment. Table F-1-1 summarizes typical daily consumption at the various types of AV-8A bases. These requirements are derived as follows:

(1) Sea Base. Two cases are shown: Twenty AV-8A's or six AV-8A's, assumed to be operated from a typical Sea Base at the rate established in Annex B of four sorties per aircraft per day. The mission is assumed to be a 50-nautical mile radius attack mission with guns and external stores. Take-off run is assumed to be 300 feet. Ordnance expended per mission is approximately 3,380 pounds (3,180 pounds of external ordnance plus 250 pounds of 30mm (200 rounds)). From Figure B-2-8, fuel consumed per mission is 2,200 pounds, or 323 gallons at 6.8 pounds per gallon JP-5 fuel. Demineralized water is consumed at 150 pounds per sortie. Material consumption is based on 17.6 pounds per man per day afloat (reference 1) and an estimate of 368 personnel to support 20 AV-8A's (squadron Table of Organization) or 160 personnel (approximately one-third of squadron plus IMA plus support) to support six AV-8A's.

(2) Sea Platform. A Sea Platform will normally have no consumption with the possible exception of fuel for topping off and demineralized water replenishment.

(3) Main Base. In the case shown, the Main Base is assumed to support 10 aircraft flying from the Main Base and an additional 10 aircraft flying from Facilities. In

TABLE F-1-1. (U) AV-8A TYPICAL DAILY CONSUMPTION FACTORS

	SEA BASE	SEA BASE	MAIN BASE	FACILITY	FACILITY
No. of AV-8A's	20	6	20	6	10
No. of Sorties	80	24	80	24	40
DAILY REPLENISHMENT, SHORT TONS (S/T) and U.S. GALLONS (GAL.)					
Ordnance, S/T	125	38	161	48	80
Fuel, S/T	88	26	91	27	45
(GAL.)	(25,800)	(7,600)	(26,700)	(7,950)	(13,200)
Water, S/T*	6	2	6	2	3
(GAL.)	(1,440)	(480)	(3,600)	(480)	(1,440)
Materials, S/T	3	1	7	1	1
TOTAL, S/T	222	67	265	78	129

* Demineralized water for jet engine use.

UNCLASSIFIED
UNCLASSIFIED

deriving fuel and ordnance consumption, the following assumptions are made:

(a) One-fourth of the sorties from the Main Base and Facilities are staging missions to Forward Sites.

(b) The average ordnance load for missions from Forward Sites is 2,600 pounds of expendable ordnance.

(c) Missions from the Main Base take off with an average of 4,500 pounds of expendable ordnance.

(d) Fuel, ordnance, and materials for the Facilities are shipped through the Main Base.

(e) Attack missions from Facilities take off with an average of 4,000 pounds of expendable ordnance.

(f) Material consumption is 26.2 pounds per man per day ashore (reference 1) for 500 personnel.

(g) Each mission consumes 150 pounds of water.

(4) Facilities. The assumptions stated above are applied to Facilities supporting six AV-8A's and ten AV-8A's, as shown in Table F-1-1. Manning is assumed to be 78 for six AV-8A's and 116 for ten AV-8A's as shown in Annex D, Table D-1-2.

(5) Forward Sites. The only routine consumption which may be required at Forward Sites is demineralized water, at 150 pounds per take-off.

b. Personnel Transport. Transportation must be provided to move personnel between the Sea Base or Main Base, Facilities, and Forward Sites. Some movements of personnel. primarily rotation of air and ground crews at Facilities, can be planned in advance, but responsive transportation is essential for unplanned personnel movements to repair unflyable aircraft, landing pads, or support equipment. Where swift and reliable means of ground transport are lacking, light or medium helicopter support is essential.

c. Other Materials.

(1) Transportation must be provided for repair parts and support equipment to meet unscheduled requirements.

(2) An additional requirement is the need to lift unflyable AV-8A's which cannot be repaired at a Facility or Forward Site. The CH-53D, which can lift the empty weight of the AV-8A on a 74-nautical mile mission radius at Sea Level, 95 degrees F., is currently available to perform this mission. In the mid-range period, the advent of the heavy lift helicopter will make possible the retrieval of fully loaded AV-8A's from Facilities and Forward Sites.

105. (U) Stockage. The levels of materiel stocked at the Main Base and Facilities represent a resolution of the conflicting demands of mobility on the one hand and supply effectiveness on the other.

a. The Main Base will be located with emphasis on accessibility by surface transport, so that it can be supplied directly from the Beach Support Area (BSA) or Logistic Support Area (LSA). Stock levels at the Main Base will depend on proximity to the supply source, availability of storage at the Main Base, and operational requirements. Fuel and ordnance represent the majority of tonnage and volume to be stocked. Pack-ups for spare parts and equipment will be established on the basis of consumption experience.

b. While it is envisioned that a Facility will be resupplied daily to meet varying operational requirements, a "safety stock" of at least one day of fuel and ordnance should generally be maintained at the Facility to insure that operational commitments can be met under adverse conditions. Spare pack-ups for Facilities will also be required.

106. (U) Deployment. Transportation and support are required to deploy the Main Base, Facilities, and Forward Sites ashore and to redeploy these as the tactical situation dictates. Because of its extensiveness, the Main Base will seldom be redeployed once it is established ashore. Early operation ashore or from a forward location may be achieved by establishing a Forward Site, incrementally expanding it to a Facility, and expanding it to a Main Base if desired.

a. Main Base. As described in Annex D, the functions performed at a Main Base resemble those of a Short Airfield for Tactical Support (SATS), as described in reference 2, with the exception that runway length need be only 1,500 feet and catapult and recovery systems are not needed. The weight and cube of Main Base support equipment is therefore estimated on the basis of SATS data. The general purpose vehicle complement is described in Section 3 of this annex, and matting requirements are established in Section 2 of Annex D. Table F-1-2 presents estimates for the weights of vehicles and

TABLE F-1-2. (U) ESTIMATED EQUIPMENT AND VEHICLES FOR AN AV-8A MAIN BASE

ITEM		WEIGHT, S/T
Matting		239
AM-6 (105,000-Square Foot Runway)	184	
MOMAT (110,000-Square Foot Parking)	55	
Vehicles		474
General Purpose (32)	187	
Power Driven Units (37)	287	
Towed Units		181
General Purpose (18)	37	
Support Units (58)	144	
Support Equipment		124
TOTAL Without Matting		779
TOTAL With Matting		1,018

equipment at a Main Base. Totals are shown without matting, representing use of an available surface, and with matting.

b. Facility. Requirements for Facility equipment, vehicles, and materials are presented in Sections 2 and 3 of this annex and Sections 2 and 3 of Annex D. These requirements are consolidated in Table F-1-3. Totals are presented without matting, representing use of available surface; with AM-6 runway matting, representing use of available surface for parking; and with AM-6 runway matting and MOMAT for a parking area.

c. Forward Site. The Forward Site is envisioned as highly mobile, readily established, and easily redeployable. It should be capable of being moved by surface means or helicopter on short notice (one day or less). The major requirement is establishment of a minimum 72 foot by 72 foot VTOL pad. As discussed in Section 3 of Annex D, approximately 9 tons of AM-6 matting are needed to establish a Forward Site in the absence of a satisfactory surface. If a parking area must also be covered, a bundle of seven MOMAT sheets, amounting to 4,170 square feet, would be ample.

TABLE F-1-3. (U) ESTIMATED MINIMUM EQUIPMENT AND VEHICLES FOR AN AV-8A FACILITY

ITEM		WEIGHT, S/T
Shelters, Billeting & Storage		4
Support Equipment & Supplies		22
TACAN, Portable	-	
Air Traffic Control Central	2	
Ordnance Frames and Cradles	7	
Ordnance Shelters (4)	7	
Generator Set, 100 kw	3	
Supplies and Tools	3	
Vehicles & Power Driven Units (17 Total)		117
1 Truck, 1/4 Ton, 4x4, Utility	1	
1 Truck, 3/4 Ton, 4x4, Cargo	3	
3 Truck, 2 1/2 Ton, 6x6, Cargo	21	
1 Truck, Tractor, 5 Ton, M52*	9	
1 Truck, Rescue, M116	4	
2 Truck, Refueling (2,000-Gallon)**	19	
2 Forklift, 6,000-Pound Capacity	18	
2 Weapons Loader, MJ-3	5	
2 Crane, M60	21	
1 Tow Tractor, TA-75	6	
Towed Units (17 Total)		31
1 Trailer, 1/4 Ton, M416	1	
1 Trailer, 3/4 Ton, M101	1	
1 Trailer, 400-Gallon Water, M149	1	
1 Trailer, Lube Unit, 1/4 Ton	1	
1 Trailer, 5,000-Gallon Water, 6x6	6	
2 Trailer, Armament, A/M-32U	5	
5 Trailer, Weapons Transport, A/M32K-4	5	
2 Electric Power Units, NC-10	7	
1 LOX Cart, 50-Gallon	1	
1 Nitrogen Cart, NAN-2	1	
1 Floodlight Unit, 5 kw, MC-2	2	
Matting, AM-6 (43,200 Square Foot Runway)		74
MOMAT (55,000-Square Foot Parking) (If Needed)		28

(Cont'd)

(U) TABLE F-1-3 (Cont'd)

ITEM	WEIGHT, S/T
TOTAL Without Matting	174
Materials	26
Vehicles and Power Driven Units (17)	117
Towed Units (17)	31
TOTAL With AM-6 Runway	248
TOTAL With AM-6 Runway and MOMAT	276

* For 5,000-gallon water trailer.
** Or one truck plus TAFDS (13 S/T)

d. General Considerations. The engineer effort necessary to establish these bases is discussed in Section 3 of Annex D. Proper site selection is vital to minimizing engineer effort and other logistic requirements ashore. Therefore, site selection procedures and trained personnel will be necessary to select the best locations for the Main Base, Facilities, and Forward Sites with respect to:

(1) Operations.

(2) Communications.

(3) Engineer effort.

(4) Transportation.

(5) Security.

SECTION 2. MAINTENANCE CONCEPT (U)

201. (U) General. The maintenance concept reflects the basing concepts postulated and is in consonance with the Naval Aviation Maintenance Program.

202. (U) Publications. All technical publications applicable to the HARRIER GR Mk 50 (AV-8A) aircraft will be published by the U.K. technical publications system. AV-8A publications will be distributed by Naval Air Technical Services and will be identified in the NAVAIR 101B-0601 series.

203. (U) Support Material List.

a. Aviation Supply Office has computed and will maintain a Support Material List (SML). The SML will reflect the total assets (spares, repair parts, and ground support equipment) required to support the weapon system. Revisions to the SML will be issued every 60 days, or more frequently as required, and will eventually be incorporated into the standard NAVAIR publications; e.g., AMMRL, IMRL, Section B.

b. The SML will be in four parts:

Part 1 - Contractor Furnished Equipment, Spares, and Repair Parts

Sub-part 1a - Hawker Siddeley Aviation Manufactured Airborne Spares/Repair Parts

1b - Spare Engines

1c - Aden Guns and Cartridge Actuated Devices

1d - Spares/Repair Parts for Contractor Furnished Ground Support Equipment

Part 2 - U.S. Furnished Equipment

Part 3 - Contractor Furnished Ground Support Equipment

Part 4 - USN General and Standard Support Equipment

204. (U) Planning Factors. The following planning factors were considered:

a. The AV-8A aircraft will be configured as defined by U.S. Navy SD-563-1.

b. Aircraft supply support will be provided for the aircraft through the Navy supply system.

c. Adequate Organizational Maintenance GSE will be provided for one squadron to operate at two Facilities and as a Main Base support. The parent or supporting M&MS will be provided adequate Intermediate Level Maintenance GSE to operate at a Main Base and to support a mobile sub-unit.

d. Flying hour average is forecast to be 35 hours per aircraft/month.

e. Calendar inspection cycle is 26 weeks.

f. Progressive Aircraft Rework (PAR) is programmed at 24 months of operation.

g. A major inspection required at 200 flight hours will be incorporated into the calendar inspection requirements and PAR inspection requirements respectively.

h. Engine overhaul is initially scheduled at 500 flight hours but is expected to be extended progressively.

205. (U) Maintenance Plan. The aircraft will be maintained in accordance with NAVAIR policies, inspection requirements, and schedules.

a. Maintenance Levels (USN/USMC). The activity of each aircraft is carefully planned by the Squadron's Maintenance Control Section, and schedules are prepared in coordination with the Squadron Operations to indicate each aircraft's progress through flying schedules and scheduled maintenance. Maintenance performed on the aircraft, aircraft systems, assemblies, components, modules, and GSE is classified into three levels.

(1) Organizational Level Maintenance consists of servicing, lubrication schedules, inspections, on-equipment corrective/preventive maintenace, and replacement of assemblies, modules, and parts.

(2) Intermediate Level Maintenance functions include bench testing, repair of removed assemblies/components within its capability, by disassembly, inspections, parts replacement, detailed adjustments, calibration, and those maintenance actions beyond the scope of Organization Level Maintenance.

(3) Depot Level Maintenance performs major repairs, modifications and programmed overhaul of aircraft, assemblies, components, and GSE which are beyond the capabilities of the lower levels of maintenance.

b. Maintenance Scheduling. Scheduled Maintenance is that maintenance which can be programmed for the life of the weapon system or support equipment. It consists of inspection of specific items or areas on a calendar or hourly basis and time replacement of items whose failure can be predicted with reasonable accuracy and those components that would compromise safety of flight or cause mission abort. Scheduled maintenance inspections will be covered by the servicing schedule. These scheduled inspections are:

(1) Turnaround/Servicing. Turnaround maintenance requirements shall be accomplished prior to the first flight of the day and after each flight. This card set combines the basic preflight and postflight requirements into a single publication containing the minimum inspection requirements to ensure the integrity of the aircraft for flight. The servicing cards contain requirements for replenishment of fuel, oil, oxygen, nitrogen, and water expended during normal flight. The turnaround cards and tasks thereon are sequentially arranged and consecutively numbered in the most logical order for performing the required tasks.

(2) Daily/Special/Conditional. Daily requirements shall be accomplished prior to the first flight of the day. The accomplishment of these requirements does not satisfy the requirements of the turnaround inspection. These requirements are to inspect for latent defects at a greater depth than the turnaround inspection. Special inspection requirements are added to the daily inspection cards scheduled to be performed on a particular day. Conditional maintenance requirements are dictated by number of events, cycles, or flight hours or by individual occurrences.

(3) Calendar Inspections. Calendar inspection requirements are to provide an inspection for the material degradation that has occurred during the calendar interval, and to identify essential preventive maintenance to a greater depth than the daily inspection.

(4) Power Plant Periodic Inspection. The inspection between overhauls will be covered by the turnaround and daily/special/conditional inspections. Complete overhaul is presently required at the expiration of 500 flying hours but is expected to be extended progressively to 1,000 hours.

c. Scheduled Replacement of Components. Certain components are scheduled to be replaced at intervals compatible with scheduled inspection and servicing intervals. Items requiring replacement are identified in the Aircraft Servicing Schedule.

d. Depot Maintenance. Progressive Aircraft Rework consists of the necessary restoration, modification, planned examination, and tests which will ensure aircraft integrity, reliability, and mission capability for the next planned operating interval. The frequency of this inspection is 24 months.

206. (U) Personnel Organization. While Section 1 of Annex D presents estimates for manning at a facility, the exact number and skills of maintenance personnel will be tailored to the requirements. Although maintenance at a Facility will be limited, maintenance organization at a Facility must be capable of maintenance control, quality assurance, maintenance administration, and supervision of each maintenance action.

207. (U) Maintenance Afloat. Liaison between the deploying AV-8A squadron and ships it will operate from will be established prior to deployment to resolve matters such as equipment, personnel, and supply requirements.

a. Sea Platforms, by definition, provide only minimum support. It is not planned that aircraft maintenance be performed on a Sea Platform. Should maintenance be required, the necessary equipment and personnel will be sent to the Sea Platform and the maintenance performed, or the aircraft may be heli-lifted or surface transported to a suitable location. When extensive operations or mission turnarounds are envisioned from a particular Sea Platform, servicing personnel may augment the ship's company.

b. When operating from a Sea Base, the squadron's intermediate maintenance level personnel will augment the ship's company while the squadron will perform its own organizational level maintenance.

208. (U) Maintenance Ashore.

a. It is not planned to perform aircraft maintenance at a Forward Site. Should maintenance be required, the necessary equipment and personnel will be sent to the Forward Site and the maintenance performed, or the AV-8A may be heli-lifted or surface transported to a suitable location.

TABLE F-2-1. (U) MAJOR GROUND SUPPORT EQUIPMENT FOR AN AV-8A FACILITY

Description	6 AV-8A's Minimum	6 AV-8A's Desired	10 AV-8A's Minimum	10 AV-8A's Desired
Tow Tractors, TA-75 Type	1	1	2	2
Electric Power Units, NC-10 Type	2	2	2	3
Liquid Oxygen Cart, 50-Gallon Capacity	1	1	1	1
Nitrogen Cart, NAN-2 Type	1	1	1	1
5,000-Gallon Water Trailer w/Tractor	1	1	1	1
Floodlight Trailer, 5 kw, MC-2 Type	1	1	1	2
Jacks and Cradle Set	1	1	1	2
Wing Jack and Trestle	1	1	1	1

b. While operating from a Facility, organizational maintenance will primarily be limited to quick engine changes, fault troubleshooting, replacement of accessible hardware, and minor repairs. More complicated organizational maintenance and intermediate level maintenance will be performed at a Sea Base or Main Base. The major ground support equipment to be located at a Facility in order to support six or ten AV-8A's is listed in Table F-2-1. It should be understood that the quantities are based on an assumed 100 percent availability of vehicles and equipment at all times. This availability is to be achieved by immediate replacement from the Base of any out-of-commission vehicles or equipment. The shelters required by the maintenance section for work and storage are contained in Section 3 of Annex D. The type shelter required and provided will depend on the climate, estimated duration of the operation at the Facility, and the availability of sheleters.

209. (U) Pilot Maintenance Responsibility. The pilot of an AV-8A will be responsible for the inspection of his aircraft at a Forward Site. He will be responsible for the inspection and the servicing of his aircraft when embarked on a Sea Platform when AV-8A trained personnel are not available.

SECTION 3. VEHICLE REQUIREMENTS (U)

301. (U) General. This section presents vehicle requirements to meet transport needs at representative AV-8A Main Bases, Facilities, and Forward Sites. These requirements are considered for support and resupply.

302. (U) Support. Support vehicles are those needed at a Main Base or Facility to meet transportation requirements within the base complex. The vehicle complement needed to support a Main Base or Facility will vary with terrain, operational requirements, and other factors. Table F-3-1 presents an estimate of the numbers of general purpose vehicles typically required at Main Bases and indicates the minimum and the desired numbers of vehicles at Facilities. The complement for a Facility does not provide for nonavailability. Deadlined vehicles would be replaced from the Main Base or other sources. Additional support from other landing force vehicle assets may be required from time to time to meet special needs. No vehicles would ordinarily be needed to support a Forward Site.

303. (U) Resupply. Resupply vehicles are those needed to transport replenishment ordnance, fuel, and supplies from a Main Base to a Facility. The numbers of vehicles needed will vary with terrain, weather conditions, and distance to the Facility. Table F-3-2 presents the number of vehicle loads to transport the daily consumption tonnages at a Facility developed in Section 1 of this annex.

TABLE F-3-1. (U) TYPICAL GENERAL PURPOSE SUPPORT VEHICLE REQUIREMENTS

TYPE	MAIN BASE	PER FACILITY REQUIRED	PER FACILITY DESIRED
Truck, 1/4 Ton, 4x4, Utility	6	1	2
Truck, 3/4 Ton, 4x4, Cargo	4	1	2
Truck, 2 1/2 Ton, 6x6, Cargo	8	3	5
Truck, M49, 6x6, 1,200 Gal Gas Trk	2	0	1
Truck, 6x6, 5,000 Gal Wtr Trk	1	1	1
Truck, M718, Ambulance, 1/4 Ton, 4x4	1	0	1
Truck, M43, Ambulance, 3/4 Ton, 4x4	2	-	
Truck, M543, Wrecker, 5 Ton, 6x6	1	-	
Crane, M60, Whl Mtd, 3 Ton	4	1	2
Trailer, M416, 1/4 Ton, Amph	2	1	2
Trailer, M101, 3/4 Ton	3	1	2
Trailer, M105, 1 1/2 Ton, Cargo	4	-	
Trailer, M149, 400 Gal Wtr Trl	4	1	2
Trailer, High Press Lube Unit, 1/4 Ton	2	0	1
Trailer, High Press Cleaning Unit, 1/4 Ton	2	0	1
Truck, 2 1/2 Ton, Dump	2	-	
Truck, M52, 5 Ton, Tractor	1	-	
Trailer, 12 Ton, Stake & Platform	1	-	
Prime Movers	32	7	14
Towed	18	3	8

TABLE F-3-2. (U) TYPICAL GENERAL PURPOSE SUPPORT VEHICLE REQUIREMENTS

CATEGORY	VEHICLE	AMOUNT	NO. OF LOADS
Six AV-8A's			
Ordnance & Materials	2 1/2-Ton Truck & 1/2-Ton Trailer	49 S/T	20
Fuel	5,000-Gallon Tanker	7,950 Gallons	2
Ten AV-8A's			
Ordnance & Materials	2 1/2-Ton Truck & 1 1/2-Ton Trailer	81 S/T	33
Fuel	5,000-Gallon Tanker	13,200 Gallons	3

[redacted]

SECTION 4. HELICOPTER REQUIREMENTS (U)

401. (U) General. In many situations, helicopters will be the most appropriate transportation mode for AV-8A support, providing rapid transportation independent of accessibility by road. As stated in paragraph 104 of this annex, transportation assets to support AV-8A will be allocated by the landing force commander. The purpose of this section is to provide a guide for estimating helicopter requirements in support of the AV-8A.

402. (C) Helicopter Capabilities. Characteristics of current and projected Marine Corps helicopters were established in CMC Project 30-69-06, Helicopter Requirements for Landing Force Operations Ashore (Update). These are summarized in Table F-4-1 below for selected helicopters.

TABLE F-4-1. (C) HELICOPTER CAPABILITIES
SEA LEVEL 95 DEGREES F.

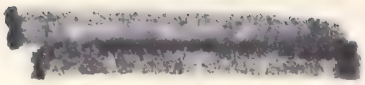
Model	Maximum Mission Radius, Nautical Miles	Payload For Maximum Radius Pounds	Average Speed KT
UH-1N	90	1,400	105
CH-46D	74*	3,100	105*
CH-53D	74*	12,500	120*
Heavy Lift**	50*	36,000**	110*

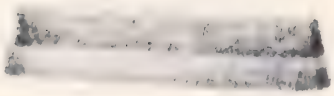
* External load one way, return empty.
** U.S. Navy Specific Operational Requirement 14-20, Sea Level 90 Degrees F.

403. (C) Helicopter Missions. The mission categories discussed below constitute the major helicopter missions envisioned for AV-8A support. Missions which can be planned in advance are identified, since helicopters need not be continually available for these missions.

a. Site Reconnaissance. A reconnaissance mission to survey potential locations will arise occasionally when a Main Base, Facility, or Forward Site is to be established. A light helicopter will suffice. This mission generally can be planned in advance.

[redacted]





[redacted]

b. Personnel and Cargo Transport. Helicopter transport is necessary for transportation of personnel, equipment, and materials to establish a Facility or Forward Site when the location is inaccessible by surface means or when it is imperative that the Facility or Forward Site be rapidly established. This mission can generally be planned in advance. Tonnages to be moved will vary with the amount of surface preparation required. The discussion which follows is based on equipment weights presented in Section 1 of this annex and installation factors presented in Section 1 of Annex D.

(1) A Facility requires 248 short tons of materials and equipment and 100 personnel, amounting to approximately 45 CH-53D sorties. Additional sorties would be necessary to transport the engineering equipment and personnel, depending on the engineer effort required. For example, to establish the Facility in 2 days on rough open terrain requires 21 pieces of engineer equipment and 76 men, amounting to eight additional CH-53D sorties. Six additional CH-53D sorties are needed if MOMAT is to be laid for the parking area.

(2) A Forward Site may require 9 tons of AM-6 matting, amounting to two CH-53D sorties, plus transport of the engineer equipment and personnel needed. To establish the Forward Site in one day on rough open terrain requires a tractor and roller, which can be carried in two additional CH-53D sorties.

c. Resupply. The replenishment of Facilities inaccessible by surface transport may require a significant number of helicopters, but can generally be planned in advance. The typical requirements derived in Section 1 of this annex amount to 78 tons per day for a Facility supporting six AV-8A's and 129 tons per day for a Facility supporting ten AV-8A's. These represent averages of 12.5 CH-53D sorties daily for six AV-8A's and 20.6 CH-53D sorties daily for ten AV-8A's. Figure F-4-1 shows the number of CH-53D helicopters required to support a Facility if CH-53D utilization averages 2 flight-hours per day. For example, three CH-53D's must be committed to resupply a Facility supporting ten AV-8A's if the CH-53D mission radius is 25 nautical miles. Approximately four times as many CH-46D's would be required, or one-third as many heavy lift helicopters meeting U.S. Navy Specific Operational Requirement 14-20.

d. Light Utility Tranport. This mission to transport air and ground crews, supervisors, support personnel, ground support equipment, and repair parts to Facilities or Forward Sites can be adequately performed by a light helicopter unless heavy ground support equipment or repair parts are required.

[redacted]

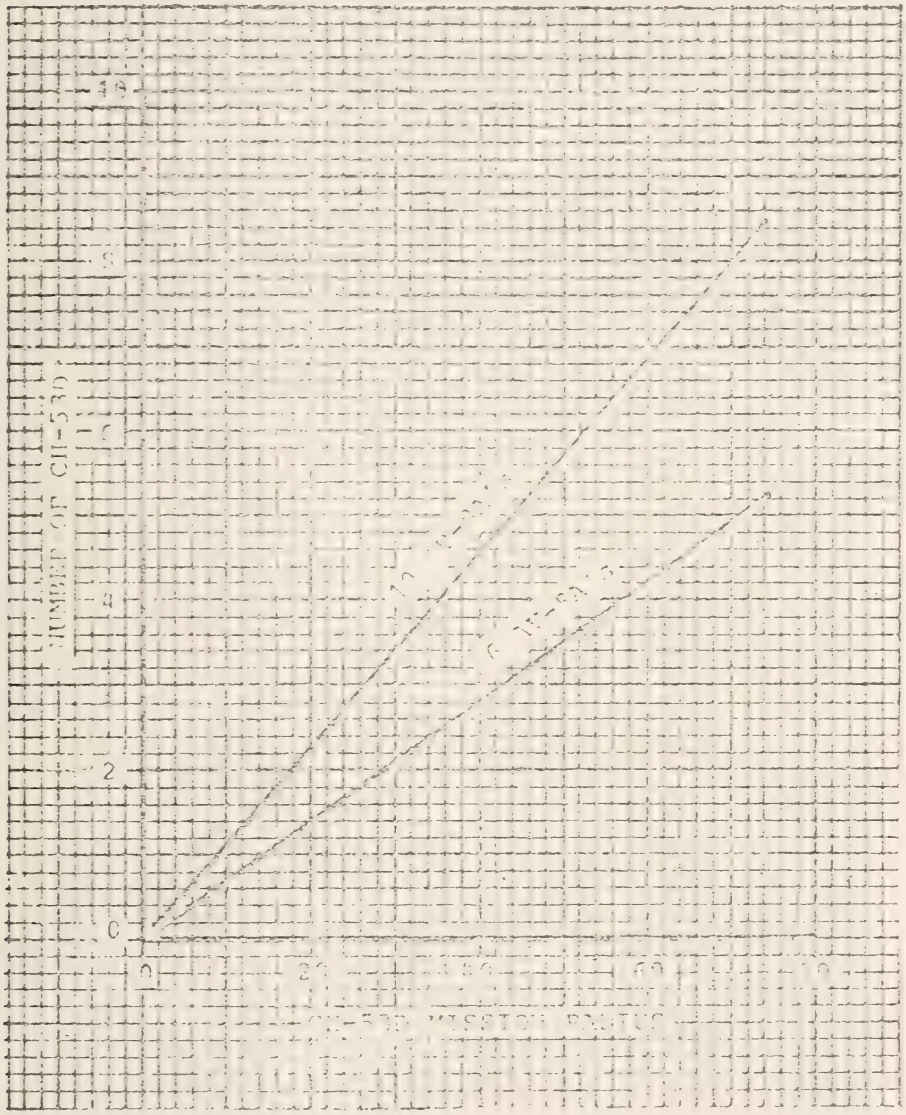




[redacted]

FIGURE F-4-1

(C) NUMBER OF CH-53D HELICOPTERS IN RESUPPLY AT AN AREA FACILITY



[redacted]





[redacted]

Helicopter transportation will be necessary when Facilities or Forward Sites are inaccessible by surface means or when the Facility or Forward Site is so distant that the time required for surface transport is deemed excessive. In either of these cases, one light helicopter should be readily available to fulfill a mission requirement generated by the need to repair an unflyable AV-8A.

e. AV-8A Retrieval. As shown in Table F-4-1, the CH-53D can lift the AV-8A empty weight on a mission radius of 74 nautical miles, and the heavy lift helicopter would be able to lift the AV-8A at maximum gross weight. This mission to move unflyable aircraft will not occur often, but prompt fulfillment when the need arises will minimize aircraft down time at Facilities and Forward Sites. Procedures will have to be developed to prepare an AV-8A for helicopter lift. These procedures would also be used to retrieve AV-8A's forced to execute emergency vertical landings at locations other than Facilities, Forward Sites, or the Main Base.

[redacted]





UNCLASSIFIED

SECTION 5. SHIPBOARD SUPPORT (U)

501. (U) General. This section provides a guide to the logistical support required by an AV-8A squadron or detachment operating from a Sea Base. The support identified is that which is beyond the normal capability of the squadron, and must generally be provided by other organizations.

502. (U) Sea Based Operation. A ship serving as a Sea Base must provide the following support for embarked AV-8A's:

a. Billeting, mess, and administrative support for embarked personnel. This amounts to approximately 160 personnel for six aircraft and 368 personnel for 20 aircraft.

b. Fuel and refueling facilities. The fuel required is normally within the capabilities of ships considered capable of serving as Sea Bases.

c. Demineralized water for the Pegasus engine, amounting to 480 gallons per day for six AV-8A's and 1,440 gallons per day for 10 AV-8A's.

d. Ordnance storage and handling. Ordnance requirements for the AV-8A are generally within the capabilities of CVA or CVS class ships, but the LPH or LHA will require augmentation of the ship's company to load, stow, break out, assemble, and deliver aviation ordnance. Stowage of aviation ordnance aboard these ships will also necessitate a reallocation of shipboard space.

e. Liquid oxygen (LOX) and gaseous nitrogen for aircraft servicing. These may be either stored or manufactured aboard ship.

f. Maintenance support. CVA and CVS class ships will require augmentation of personnel, equipment, and spares to provide intermediate maintenance (IMA) support for AV-8A operations. When AV-8A's are embarked aboard the LPH or LHA, the embarked echelon must include IMA support or an augmented spares pack-up. The Sea Base must also provide access to a responsive requisitioning, transportation, and issue system to cycle repairable equipment and fill high-priority requisitions.

g. Replenishment. Reliable replenishment of all classes of supply must be provided to support the tempo of operations.

h. Photo processing. If the AV-8A is used for photo reconnaissance, the Sea Base must provide photo processing and interpretation.

UNCLASSIFIED

UNCLASSIFIED

503. (U) Operation From Sea Platforms. AV-8A's operating from Sea Platforms must be supported from a Sea Base; therefore, a minimum of logistic support is required from the Sea Platform. If the Sea Platform can support rearming and refueling, AV-8A's landing on the Sea Platform can be turned around for subsequent missions. Generally, however, mission ready AV-8A's will be flown to the Sea Platform from a Sea Base. In any case, a refueling capability is desired at the Sea Platform to top-off fuel on aircraft staging from the Sea Base. It is also desired that a CH-53D or heavy lift helicopter be available to retrieve unflyable AV-8A's from a Sea Platform.

504. (U) Embarkation. If it is planned to phase AV-8A's ashore in an amphibious operation, additional support elements must be embarked aboard amphibious shipping. These support elements constitute the surface echelons. Typically, these echelons will include the following support elements for AV-8A:

a. First surface echelon, to be landed with assault elements of the ground component, will include forward command and control elements and those elements necessary to establish a Forward Site.

b. Second surface echelon, to be landed during general unloading, will include those additional elements necessary to establish and operate a Facility.

c. If a Main Base is to be established, additional elements necessary to establish a Main Base will be included in the third surface echelon transported in subsequent shipping. This echelon will also include elements necessary to establish additional Facilities and Forward Sites, as desired for the operation.

SECTION 6. SUPPORT ASHORE (U)

601. (U) General. This section identifies major logistic support peculiar to the AV-8A which is beyond the squadron's normal capability. This support must be planned for in establishing logistics plans, composition of the landing force, and the AV-8A concept of employment for the amphibious operation. Particular consideration of AV-8A logistic requirements is essential because the basing and supporting concept imposes requirements not normally associated with operations of conventional aircraft and helicopters.

602. (U) Marine Aircraft Group. The support required which falls within the functions of the Marine Aircraft Group (MAG) will be provided by elements of the MAG to which the AV-8A is assigned, either permanently or temporarily. In addition to the command, supervision, and planning normally provided by the group commander and his staff, provision must be made for photo processing and interpretation (if used in a photo reconnaissance role) and for operation of the logistic system to support Facilities located at some distance from the Main Base. In conjunction with the support of dispersed operations, it will be highly desirable for the aviation element to augment the shore party in order to advise and assist the shore party in control and handling of AV-8A items, arrange for delivery of high-priority items directly to Facilities, arrange for and assist in helicopter lift, and otherwise expedite logistic support. The following logistic support requirements are peculiar to the AV-8A and may require augmentation from the supporting Group.

a. Headquarters and Maintenance Squadron (H&MS) functions:

(1) Supply support for requisition, storage, issue, and accounting must be extended to Facilities as well as the Main Base.

(2) Administrative support must be extended to Facilities.

(3) Ordnance dumps at Facilities must be established, supported, and replenished.

(4) Deadlined vehicles and equipment at Facilities must be promptly replaced and cycled to the Main Base or other installation for repair.

b. Marine Air Base Squadron (MABS) functions:

(1) Utilities, mess, administrative, and base maintenance support must be provided at Facilities as well as the Main Base.

(2) Supply storage and distribution must also be provided at Facilities.

(3) Communication support must be extended to Facilities and, if necessary, Forward Sites.

(4) MATCU elements must be deployed and supported at Facilities and possibly at Forward Sites.

603. (U) Marine Aircraft Wing

a. AV-8A operation will impose the following requirements for logistic support normally provided by the Marine Wing Support Group (MWSG):

(1) Matting and other base equipment must be provided to establish the Main Base, Facilities, and Forward Sites.

(2) It may be necessary to establish a Tactical Airfield Fuel Dispensing System (TAFDS) at Facilities as well as the Main Base.

(3) The MABS may require augmentation or support by the MWSG in order to provide the logistic support described in paragraph 602b.

b. Helicopter support will be necessary to meet the requirements presented in Section 4 of this annex.

604. (U) Other Landing Force Elements. AV-8A operation will impose the following requirements for logistic support from other elements of the landing force:

a. AV-8A needs must be considered in formulating logistic support requirements, concepts, and plans.

b. Engineer support will be required to establish the Main Base, Facilities, and Forward Sites.

c. In addition to delivering supplies and equipment to the Main Base, it may be desirable to provide delivery of selected items directly to Facilities.

d. Motor vehicle support from landing force transport elements may be necessary to establish and resupply Facilities.

[redacted]

(U) REFERENCES

1. Department of the Navy, NWIP 11-21(D), Logistic Reference Data (U), 1 Dec 69 (Confidential).

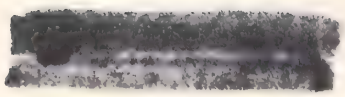
2. Naval Air Systems Command, NAVAIR 51-35-1, Logistics Analysis - Initial Staging Area to Field Installation - Short Airfield for Tactical Support, 1 Jan 67 (Unclassified).

WARNING

This material contains information affecting the National Defense of the United States within the meaning of espionage laws, Title 18, U. S. C. Sections 793 and 794. Its transmission or the revelation of its contents in manner to an unauthorized person is prohibited by law.

CLASSIFIED BY CMC (MH)
SUBJ TO GENERAL DECLASSIFICATION
SCHEDULE OF EXEC. ORDER 11652
AUTOMATICALLY DOWNGRADED AT TWO-YEAR INTERVALS
DECLASSIFIED ON 31 DECEMBER 1979

[redacted]





[redacted]

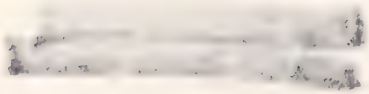
WARNING

This material contains information affecting the National Defense of the United States within the meaning of espionage laws, Title 18, U. S. C. sections 793 and 794, its transmission or the revelation of its contents in manner to an unauthorized person is prohibited by law.

CLASSIFIED BY CmC (CAY)
SUBJ TO GENERAL DECLASSIFICATION
SCHEDULE OF EXECUTIVE ORDER 10652
AUTOMATICALLY DOWNGRADED AT TWO YEAR INTERVALS
DECLASSIFIED ON 31 DECEMBER 1979

[redacted]





[redacted]

ANNEX G - WEAPON EFFECTIVENESS (U)

SECTION 1. INTRODUCTION (U)

101. (U) General. This annex considers the effectiveness of the AV-8A against a spectrum of enemy targets. The work was done at the Naval Weapons Center, China Lake, California under funding provided by the Marine Corps Development and Education Command. The basic reason for this annex is to be able to specify the weapons in the basic complement to supply a deployed AV-8A squadron in order that it can carry out its mission with maximum effectiveness. Among the factors that contribute to determining effectiveness are:

a. The target spectrum.

b. The list of candidate weapon systems for the AV-8A.

c. The effectiveness of the weapons against the spectrum of targets.

102. (U) Assumptions. There are many factors to consider in weapons effectiveness, such as the delivery accuracy of the AV-8A's attack system, variation of pilot ability, target detection and identification, and enemy air defense systems. Some of these factors are quantifiable, others are not. The following assumptions are made in assessing effectiveness against individual targets:

a. Target detection and identification have taken place and the pilot has a well-defined aim-point. Delivery accuracy achieved will be between that of the CP-741 and a 10-mil combat system.

b. With the exception of mixing guns with other types of ordnance, only one type of ordnance will be carried on a mission by any one AV-8A.

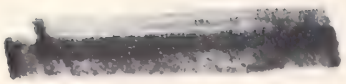
c. Only existing weapon effectiveness and target vulnerability data will be used. The Joint Munitions Effectiveness Manual (JMEM) (reference and or the Tactical Air Armament Study (TAAS) (references 2 and 3) were used to compute kill probabilities of targets discussed in this Annex. The Tactical Air Armament Plan contained in TAAS was assumed as the authority for determining what weapons would be in the arsenal during this time frame (present to 1980). Weapons scheduled for phaseout by the end of FY 1972 were not considered.

WARNING

This material contains information affecting the National Defense of the United States within the meaning of espionage laws, title 18, U. S. C. sections 793 and 794. Its transmission or the revelation of its contents in manner to an unauthorized person

CLASSIFIED BY... Cmc (J3F)
SUBJ TO GENERAL DECLASSIFICATION
SCHEDULE OF EXECUTIVE ORDER 11652
AUTOMATICALLY DOWNGRADED AT TWO YEAR INTERVALS
DECLASSIFIED ON 31 DECEMBER 1971

[redacted]





[redacted]

103. (U) Missiles. In the case of missiles, this annex includes a discussion of the possible effectiveness of the missiles and the problems involved in configuring the AV-8A for the missile (i.e., what black boxes, launchers, and displays would be required). In this way, the potential effectiveness of the missile can be weighed against the aircraft modifications that would be required to fire the weapons. The missiles considered include Shrike, Bulldog, Maverick, and Harpoon. The AV-8A is already compatible with Sidewinder.

104. (U) Guns. The consideration of the AV-8A's Aden 30mm guns is very limited by lack of data on the characteristics of the 30mm round and actual vulnerability to the 30mm round of the targets considered.

105. (U) Air-to-Air Role. This annex includes a brief discussion of the effectiveness of the AV-8A in the air-to-air role. Lack of sufficient aerodynamic data to plot energy maneuverability curves has limited this portion to a qualitative discussion.

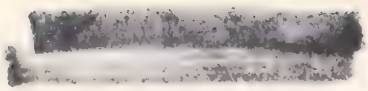
106. (U) Support Requirements. The factors determining weapon selection include the resources required to support the employment of the weapons in addition to the effectiveness expected from their use. In order to provide a basis for assessing the capabilities of the AV-8A in the various operational options considered, this annex contains a discussion of the support equipment and personnel needed to supply and maintain the weapon complement selected.

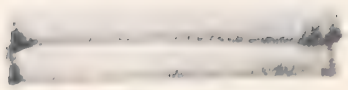
107. (U) Methodology. The basic methodology used to determine weapon effectiveness for the AV-8A was to (a) identify the basic missions, (b) identify the potential targets that are most likely to be encountered on these missions, (c) describe the targets and their vulnerability, (d) determine ordnance loads and delivery accuracy for the AV-8A, (e) determine the effectiveness of the ordnance loads against the targets, and (f) determine the most effective ordnance for the AV-8A in its various missions.

WARNING
This material contains information affecting the National Defense of the United States within the meaning of espionage laws, title 18, U. S. C. sections 793 and 794. Its transmission or the revelation of its contents in manner to an unauthorized person is prohibited by law.

[redacted]

CLASSIFIED BY CMC (AX)
SUBJ TO GENERAL DECLASSIFICATION
SCHEDULE OF EXECUTIVE ORDER 11652
AUTOMATICALLY DOWNGRADED AT TWO YEAR INTERVALS
DECLASSIFIED ON 31 DECEMBER 1979





SECTION 2. MISSIONS (U)

201. (U) General. Three missions are considered for the AV-8A: Close Air Support (CAS), Deep Air Support (DAS), and Armed Reconnaissance (ARREC). These missions, described below, are not to be construed as the only possible missions for the AV-8A. This annex is concerned only with the AV-8A as a weapon-delivery aircraft. While weapon effectiveness is addressed primarily, mission effectiveness will also be affected by the factors discussed in subsequent paragraphs of this section.

202. (U) Close Air Support Mission. The most frequent mission for the AV-8A will be the CAS mission. It is assumed that 85 percent of the AV-8A sorties will be flown in the CAS role. The definition of this mission is:

> Air attacks against hostile targets which are in close proximity to friendly forces and which require detailed integration of each air mission with the fire and movement of those forces.

a. The CAS mission involves delivery of ordnance by air against a variety of targets in close proximity to friendly forces who are engaged with the enemy. In this mission, friendly force safety is critical, hence positive control of the aircraft is required as well as positive target identification and accurate weapon delivery.

b. Quick response is a desired characteristic, particularly when the requirement for air support is generated by enemy initiative. The need to attack a variety of targets successfully may dictate availability of several ordnance types.

c. A necessity in this mission is a rapid and reliable communication net between the ground commander, the forward air controller, and the aircraft pilot.

d. The targets encountered in this mission will depend on the area of conflict and the nature of the enemy.

e. It is nearly impossible to set down universally applicable frequencies of encounter for the various targets that are likely to be encountered in the CAS mission. The following CAS targets are listed in an order of assumed decreasing frequency:

(1) Troops (defensive) in foxholes, crouching.

(2) Small weapon positions (mortar, artillery, machinegun, light air defense).

(3) Trucks or wheeled vehicles.

(4) Troops (offensive) in open, prone.

(5) Armored vehicles.

(6) Bunkers.

(7) Supply caches.

(8) Bridges.

(9) AAA sites.

(10) Road and trail junctions, chokepoints.

f. As an approximate measure of frequency, the first five categories of targets are expected to account for about 90 percent of the sorties and the last five categories about 10 percent of the sorties in the CAS mission.

203. (U) Deep Air Support Mission. The DAS mission for the AV-8A includes preplanned missions against fixed enemy positions for interdicting enemy supplies or columns or for destroying enemy offensive or defensive fixed positions. These missions, in contrast to the CAS mission, are not conducted in close proximity to friendly forces; therefore, the same high degree of controlled communications and close coordination is not required because friendly force safety is not usually in question.

a. Approximately 10 percent of AV-8A sorties should be in support of the DAS mission. The following is a list of DAS targets in an assumed decreasing frequency of occurrence:

(1) Field supply caches (gas, ammo, diesel fuel).

(2) Buildings.

(3) Bridges.

(4) Trail and road junctions and chokepoints.

(5) AAA sites.

(6) Truck parks.

(7) Armored vehicle parks.

(8) Fixed weapon positions (caves, bunkers, pillboxes).

(9) Runways.

(10) Docks.

b. As an approximate measure of frequency, it is estimated that the first three categories of targets will occur on 77 percent of the DAS mission sorties; categories 4, 5, and 6 on 12 percent of the sorties; and categories 7 to 10 on 11 percent of the sorties.

204. (U) Armed Reconnaissance Mission. The AV-8A ARREC mission, although a planned mission, is not conducted against planned targets. As the name implies, these sorties are search and attack missions against targets of opportunity, along assigned routes. For the AV-8A, the inherent photographic reconnaissance capability will frequently be employed on the ARREC mission. Many of the targets encountered in the ARREC mission are mobile and the enemy has the option of when or whether to expose these targets.

a. Armed reconnaissance missions should account for 5 percent of the total AV-8A sorties. The targets most likely to be encountered on this mission are listed below in an assumed decreasing frequency of occurrence:

(1) Trucks and towed weapons.

(2) Tanks and armored vehicle columns.

(3) Watercraft (PT boats, cruise missile boats, waterborne logistic craft).

(4) Road and trail junctions, chokepoints.

(5) Bridges.

(6) Troops in the open, prone.

(7) Weapon positions (mortar, rockets, artillery).

UNCLASSIFIED

b. As an approximate measure of frequency, it is assumed that the first four target types will account for about 85 percent of the armed reconnaissance sorties and types 5 to 7 will account for 15 percent of the sorties.

UNCLASSIFIED

[redacted]

SECTION 3. TARGET DESCRIPTIONS AND VULNERABILITY (U)

301. (U) General. The selection of targets for determining AV-8A effectiveness was made by first determining a set of targets typically encountered by Marine air in amphibious engagements. This makes an "ideal" list of targets. Vulnerability data and weapon effectiveness data were not available for all targets on the ideal list, so a set of "representative" targets was chosen from targets used in the TAAS.

a. A target is considered a representative for a group of targets if it is similar in the sense that the weapon used to kill the representative target most effectively will also kill the targets in the whole group. Although this may not always be true, it is believed that for the targets selected in this study, such is the case.

b. Table G-3-1 shows the ideal list and the representative list. The targets have also been grouped by type. Descriptions of the targets and the vulnerability of the targets follow the table. The kill probabilities for the weapons against these targets appear in Section 6 of this annex.

302. (C) Troops. Troops will always represent a frequently encountered target in Marine close air support. We consider troops in both offensive and defensive postures. The material used is drawn from JMEM and TAAS.

a. Troops, Offensive. In the offensive role, troops are attacking and will be considered in the open (as opposed to being in foxholes and trenches). Three area sizes are considered for comparison: 1,000 feet by 1,000 feet; 1,000 feet by 100 feet; and 150 feet by 300 feet. The troops are considered uniformly distributed over these areas.

(1) The 5-minute assault criterion is employed, which assumes that the degree of incapacitation is such that the person will be unable to perform his active assault role within 5 minutes. Several damage mechanisms will be considered--fire, blast, and fragments, but the last is the most generally employed and most widely effective. In a combined blast/fragmentation weapon, the fragmentation portion overrides all blast damage in most target cases.

(2) In evaluating the effectiveness of fragmenting type munitions against personnel targets, it is necessary to know both the area presented by the targets to the fragment spray and the probability that a hit on that area by a fragment of known weight and velocity will incapacitate the target. The presented area will be quite different if the man

[redacted]



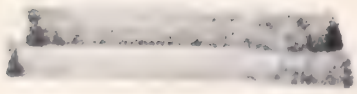
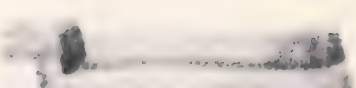


TABLE G-3-1. (C) AV-8A TARGET LIST		
	IDEAL TARGETS	REPRESENTATIVE TARGETS
Troops	Troops, Offensive Troops, Defensive	Troops in the Open, Prone Troops in Foxholes, Crouching
Vehicles	Tank, Medium, Quad 23mm AA Gun Tank Column; Armored Vehicle Park Armored Personnel Carrier Truck; Towed Artillery Truck Park; Truck Convoy	T-54 Medium Tank Tank Column Armored Personnel Carrier Truck Truck Park
Field Fortifications	Bunkers; Trenches; Tank Ditch Pillbox Hardened Cave	Bunker Pillbox Hardened Cave
Field Supply Dumps	Supply Point; POL Dump; Ammunition Dump	Caches: Ammo, Gas, Diesel Fuel
Weapon Positions	Field Artillery Position; Mortar Position; Rocket Battery; Machinegun Position; Light Air Defense Site; CMR/CBR Site AAA Site	Artillery Site (1 gun) 6-Gun 57mm AAA Site
Bridges	Railroad Bridge Road Bridge	Steel Trus RR Bridge Temporary Wooden Bridge
Watercraft	PT Boat; Destroyer; Logistic Craft	KOMAR, USS DLG-16; Waterborne Logistic Craft
Miscellaneous	Building; Runway; Dock	Building; Runway, Dock
Aircraft	Enemy Fighter	Soviet Fighters: MIG-17, -21





[redacted]

is standing or prone, but is assumed that air attacks are seldom so unexpected that a man cannot throw himself flat before the weapon arrives. The presented areas for prone troops only have been used. For a complete analysis of the types of wounds and their severity, refer to JMEM.

(3) For flame weapons effects, the methodology is very rudimentary. The Mk 77 fire bomb has a pattern of zones of relative burning intensity, and conditional kill probabilities are computed for a man suffering second-degree burns in various zones of the fire bomb pattern. A more precise description is given in JMEM.

b. Troops, Defensive. In the case of troops in the defensive role, it is assumed that they are protected or dug in and are crouching in foxholes with helmets on. Again, three area sizes are considered for comparison: 1,000 feet by 1,000 feet; 1,000 feet by 100 feet; and 150 feet by 300 feet. The troops are considered uniformly distributed over these areas.

(1) The 30-second defense criterion is employed which assumes that the subject will be unable to perform even the less strenuous duties of dug-in defense for 30 seconds. For this position of the target, as well as for the previous prone position in the open, fragments, blast, and flame are possible kill mechanisms, and again, fragments are the most important.

(2) In the case of flame weapons, the reader is referred to the previous paragraphs on prone troops. Since gelled napalm does not splash down into foxholes very well, it is expected that only one out of seven men in foxholes will be splashed by napalm. The conditional probability of severe second-degree burns for men in foxholes is thus estimated as one-seventh that of prone men on the surface of the ground.

303. (C) Armored Vehicles. Armored vehicles are another group of targets that are expected to be encountered in most Marine engagements. The armored vehicles considered in this study include the Soviet T-[redacted]edium tank and Soviet BTR-50P armored personnel carrier (Ar[redacted]. The kill criteria used for these targets are M or F and K for the tank and M or P for the APC. These criteria are defined as follows:

(1) M-Kill. A tank or an APC suffers a mobility kill if it is incapable of exercising controlled movement and is not repairable by the crew on the battlefield.

[redacted]





[redacted]

(2) F-Kill. A firepower kill is inflicted on a tank if the main armament is put out of action, either because the crew has been rendered incapable of operating it or because the armament or its associated equipment has been so damaged as to render it inoperative and unrepairable by the crew on the battlefield.

(3) P-Kill. An APC suffers a P-kill if the cargo personnel are incapacitated. The P-kill is calculated as the ratio of the expected number of personnel incapacitated to the total number of personnel being transported in the personnel compartment of the APC.

(4) K-Kill. A target is destroyed or a K-kill suffered if it is damaged beyond repair or damaged to the extent that repair is no longer economically feasible.

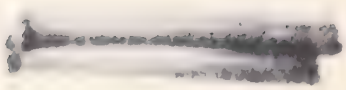
(5) The "or" used is the logical-inclusive "or" so that an "M or P" kill means an "M" or a "P" kill, or both. Brief descriptions of these targets follow; more detailed descriptions can be found in JMEM.

a. Soviet T-54 Medium Tank. The T-54 medium tank is a full-tracked combat vehicle that carries a crew of four men. This 40-ton tank is the standard medium tank of the Soviet bloc and is considered to be one of the outstanding medium tanks in use today, primarily because of its 250-mile cruising range and the firepower of its 100-millimeter gun. The T-54 is also used as a mine-clearing and flame-throwing tank, and its basic chassis is used for recovery vehicles, tank-mounted assault bridges, and the ZSU-57/2 self-propelled antiaircraft gun.

(1) The vulnerability numbers used for the T-54 tank were taken from the TAAS. For large blast-fragmentation weapons, the primary damage mechanism being considered is that due to blast and earth cratering and is presented as an allowable miss distance from the edge of the tank. Data for conical shaped charge weapons is presented as a vulnerable area of the target, since these weapons require a direct hit. The vulnerability of armored tanks to flame weapons is highly dependent upon the training and reaction of the crew. It is quite probable that a near miss short of the target which splashes napalm on the target will not be effective if the crew does not panic and drives the vehicle out of the fire bomb burn area and then puts out the fire which may be burning on components on the outside of the vehicle. Moreover, the Mk 77 fire bomb is unstable in flight and has a very large ballistic dispersion (53 mils). Therefore, since it is questionable that flame can kill a tank and since it is most

[redacted]





[redacted]

improbable that the bomb can hit the tank, the Mk 77 fire bomb is considered as unsuitable for use against tanks.

b. Tank Column. A tank column consisting of 10 T-54 tanks in a 600-foot column is considered as a target.

c. Soviet BTR-50P Armored Personnel Carrier. The BTR-50P APC normally carries a crew of three and a personnel load of 12. The BTR-50P has the same chassis as the Soviet PT-76 amphibious light tank. The primary armament of the BTR-50P is a 12.7mm machinegun.

(1) In the TAAS the APC was not considered as a "weapon determining" target. That is, it was felt that the same weapons used for tanks would be used for the APC because of the "softer" nature of the APC. Accordingly, kill probabilities were not computed in TAAS for APC. Subsequently, however, a comparison was made at NWC for the effectiveness of Rockeye II and Anti-Personnel Anti-Materiel (APAM) against the BTR-50P. The data generated in that comparison (reference 4) are presented in this study to give an indication of the effectiveness ness of the AV-8A against APC's with the APAM weapons.

304. (C) Trucks. This annex considers the Soviet ZIL-157 6 by 6 truck. This truck is described in detail in the TAAS.

a. The carrying capacity of the truck on dirt roads or cross-country is 5,500 pounds, while the carrying capacity on improved or paved roads is 9,900 pounds. The vehicle is designed for transporting cargo and troops and is also equipped for towing guns, trailers, and other wheeled units. The same basic chassis is used for a radar-equipped van, the ZIL-157G, and a semitractor with a fifth wheel, the ZIL-157V.

b. The truck target is considered both as an empty vehicle and loaded with 55-gallon drums of gasoline. These gasoline drums are made of steel with a nominal thickness of 16 gauge and are stacked on end in the cargo bed of the truck.

c. The damage criteria considered for this vehicle were two different values. The first of these was a mobility kill of the A-category. This damage level specified that if selected components of the vehicle are damaged, the vehicle will be incapable of controlled movement within 2 minutes after the weapon interacts with the target. A list of the critical components for an A-category mobility kill are shown in reference 5.

[redacted]





[redacted]

d. The second damage criterion considered is a K-kill which is sufficient destruction of the vehicle to render it unstable and not economically feasible to repair. Complete destruction as a K-kill can be achieved by a blast damage mechanism if it is sufficiently close to crush the vehicle or by fire from a damage mechanism opening the fuel tank and igniting the resulting fuel-air mixture.

e. Effectiveness data for the weapons considered are taken from references 2, 3, and 4. The vulnerability numbers for the K-kill of the truck are based on a lethal miss-distance for the general purpose bombs and Bulldog. Values for the Zuni 5-inch rocket and the 1.75-inch FFAR are given in terms of allowable miss-distance from the fuel tank of the truck to start a killing fire. For Mk 77 firebombs, the criterion is that a K-kill will be obtained 20 percent of the time if a hit is obtained within a burning zone capable of igniting rubber.

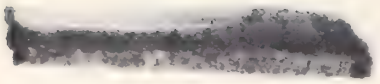
305. (C) Truck Park. The truck target is also considered for an area truck park. This target is considered to be an area which is 1,000 feet by 1,000 feet and contains 100 Soviet ZIL-157 trucks homogeneously distributed over the park area. It is assumed that these trucks will be unloaded while in the truck park area so that the inflammable load will not be considered with the vehicle.

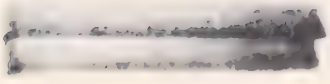
306. (C) Field Fortifications. The most frequently occurring field fortification will undoubtedly be the bunker which can contain a variety of individual and crew-served weapons. Harder fortifications such as concrete pillboxes occur relatively infrequently in the post-World War II time frame but will be considered as a case of a very hard point field fortification. A target of more frequent occurrence today is the hardened cave. A hardened cave can contain guns or missiles and will frequently occur in coastal areas. The targets are described briefly below and in more detail in JMEM and TAAS.

a. Bunker. The bunker is assumed to be a protective embankment or dugout improvised from indigenous material. A typical bunker is 15 feet long, 7 feet wide, and 8 feet deep. It is lined with 6-inch diameter logs and covered with 12-inch diameter logs, two layers of sandbags, and 4 feet of earth. The sides are completely buried.

(1) The desired level of damage for this target is breaching of the walls or ceiling, causing a complete breakdown of structural integrity and possible filling by dirt and debris, thereby rendering the bunker unusable.

[redacted]





[redacted]

(2) Earth shock and cratering are the primary damage mechanisms used against bunkers. If the crater intersects the bunker wall or the vertical projection of the wall to the earth's surface, the walls and ceiling will be sufficiently damaged to render the bunker unusable.

b. Pillbox. The pillbox is reinforced concrete, completely buried, 16 feet long, 16 feet wide, and 9 feet deep. The walls are 3-foot thick concrete, reinforced with mild steel bars, one percent by volume. The desired damage level is breaching the walls or ceiling to cause a complete breakdown of structural integrity and possible filling with scabbing and debris. Earth shock is considered the prime kill mechanism against pillboxes.

c. Hardened Cave. A hardened cave in which guns or missiles may be installed has been described and weaponeered by the Pacific Air Force (reference 6). The cave has 3-foot thick concrete walls and ceiling as described for pillboxes. A steel plate door can be opened and the gun or missile fired. The kill criterion for the cave is breaching the concrete lining of the cave, rupturing the steel door, or actually detonating the weapon inside the cavity of the cave. Any of these three things requires a bomb penetratration of 19 to 25 feet to affect the usefulness of the cave. Smaller weapons such as guns, rockets, or cluster munitions are deemed ineffective against this target.

307. (C) Field Supply Dumps. Three types of field supply dumps (caches) are considered as targets. Each cache is small, of an amount which would have been unloaded from a single truck. The target descriptions and vulnerability estimates are based on JMEM. The three types of supply caches considered are as follows:

Stacked ammunition: 8 feet by 14 feet by 5 feet.
Gasoline drums: 8 feet by 14 feet by 3 feet.
Diesel drums: 8 feet by 14 feet by 3 feet.

a. Ammunition Cache. As per JMEM, U.S. 90mm HE rounds are used in the absence of comparable Soviet data. The damage criterion for the ammunition stack requires complete destruction of a stack. It is assumed that when a high order detonation of a projectile occurs, the stack is destroyed.

b. Gasoline and Diesel Fuel Caches. The stacked gasoline and diesel drums have as a damage criterion the destruction of, or setting fire to, 50 percent of the drums in the unit. The primary damage mechanisms for both gasoline and diesel drums are fragments, shaped charges, flame, and blast.

[redacted]





[redacted]

308. (C) Artillery. This annex considers both field artillery and antiaircraft artillery (AAA).

a. Field Artillery. A field artillery piece is a very hard target to destroy due to its small vulnerable area. A small artillery position, a mortar site, or an automatic weapon position are considered as a small group of personnel located around a piece of equipment, and the kill criterion is looked on as a personnel kill rather than actually destroying the weapon. No such target was used in the TAAS study, but effectiveness numbers were available for the Zuni with the Mk 63 VCMR warhead. Those numbers are presented in this annex for completeness, but no comparative numbers are available for other weapons. This target will be assumed to represent such typical targets as a field artillery piece, a mortar position, a machinegun position, observation post, or a rocket battery.

b. AAA Site. This target is assumed to consist of six 57mm AAA guns (S-60) on the circumference of a 300-foot diameter circle. The PUAZO gun director/radar set is generally set off to one side and well hidden, so its vulnerability is not considered as part of the target. Each gun is in a well-revetted emplacement, 20-feet on a side.

(1) Each gun in the site requires a crew of eight for full operation. The S-60 has four modes of operation, varying from manually operated with automatic sight to completely automatic by remote control with the crew in bunkers.

(2) If it is desired to kill the guns themselves so that they cannot be fired, it is found that a gun is an extremely hard target with a very small vulnerable area, of the order of 2.6 square feet.

(3) Within this annex, the numbers computed represent the expected number of guns silenced as a result of incapacitating at least five of the eight operators.

309. (C) Watercraft. The targets considered here are the KOMAR Class Guided Missile Patrol Boat, a Waterborne Logistics Craft (WBLC), and a Guided Missile Frigate. While it is conceiveable that other ships might be encountered, these three ships represent a wide variety in terms of size and vulnerability, and some data are available from the TAAS for these targets.

a. KOMAR PTG. As noted in JMEM, the KOMAR Guided Missile Patrol Boat is a high speed boat having limited offshore cruising ability. Its most outstanding feature is the

[redacted]







capability of launching guided missiles against surface ships beyond the range of naval guns.

(1) The main armament of the KOMAR consists of two SS-N-2 guided missiles carried on inclined launch rails. The warhead of the missile weighs almost 1,150 pounds. In addition to the missiles, a dual 25mm "over and under" AA gun is mounted on the foredeck. This gun is manually aimed and fired.

(2) The damage criterion considered for this watercraft is a sink kill. The vulnerability numbers used for the general purpose bombs are taken primarily from reference 7. For these weapons, it is assumed that underwater explosions can rupture a hull and cause shock damage to the boat's electronic and mechanical equipment.

b. Waterborne Logistic Craft (WBLC). The diversity in size and construction of the WBLC, as well as the variation in cargo types, density, and distribution, makes it difficult to assess the vulnerability of the WBLC. The WBLC was assumed to be more lightly constructed than the KOMAR. Curves for the probability of sinking the vessel were constructed by assuming that the WBLC hull possessed about two-thirds the strength of the KOMAR hull to resist underwater blast.

c. Guided Missile Frigate. In the TAAS, it was desired to compute kill probabilities for a large ship like the Soviet KRESTA Guided Missile Cruiser. Sufficient data were not available for the KRESTA, so a U.S. ship, DLG-16, was substituted. The DLG-16 is approximately 530 feet long with a beam of 53 feet and a draft of about 19 feet. Its full load displacement is 7,650 tons.

(1) The only kill level considered in TAAS was that of seaworthiness. The damage processes considered were blast, fragments, and fires. The possibility of ignition or detonation of fuel or explosives is included in the probability of kill. It was determined that for GP bombs to be capable of rendering the CLG-16 unseaworthy, they must have steel nose plugs and electrical tail fuzes. The AV-8A is not compatible with electric fuzing, hence its capability against a ship of the DLG-16 type is considered marginal.

310. (C) Bridges. The bridges to be considered, include a temporary wooden bridge and a heavy steel truss railroad bridge.

a. Temporary Wooden Bridge. The bridge used in this study is a single lane deck bridge capable of a load-carrying



[redacted]

capability of about 16 tons for wheeled vehicles or approximately 12 tons for tracked vehicles. This capability would accommodate such vehicles as the Soviet ZIL-133 or the MAZ-500 cargo trucks which carry payloads of between 8 and 9 tons. The kill criterion employed for the wooden bridge is dropping the span.

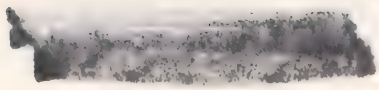
b. Steel Truss Bridge. The steel truss bridge considered is a Pratt high truss railway bridge, as described in reference 2. The bridge is 300 feet long and 20 feet wide consisting of two spans of 150 feet each. The kill criterion for this bridge is to collapse a span. The massive nature of the bridge requires direct hits on selected portions of the bridge with relatively large weapons to accomplish the needed damage.

311. (C) Building. The building considered is a two-story wood-frame building. The dimensions in the ground plane are 98 feet by 35 feet. The damage criterion is collapse of the structure.

312. (U) Docks. No specific vulnerability data for a wooden dock were available. A wooden dock with many heavy pilings would probably be considerably harder than the temporary wooden bridge described above, but definitely more vulnerable than the steel truss bridge. Weapons appropriate for the wooden and steel bridges would be appropriate for the dock.

313. (C) Runway. Runways for most modern jet aircraft are concrete. The TAAS discusses the problem of airfield attack and points out that, with current weapons, very large numbers of sorties are required to attain even a minimal level of airfield neutralization.

[redacted]





[redacted]

SECTION 4. WEAPON CANDIDATES FOR THE AV-8A (U)

401. (C) General. The selection of weapons used in this annex includes weapons in the current arsenal as well as weapons in the R&D cycle that are expected to be introduced to the fleet by 1980. The choice of which weapons was determined by utilizing the Tactical Air Armament Plan of the TAAS. Table G-4-1 gives the list of current weapons considered in this study. Table G-4-2 gives the list of R&D weapons included in the study. R&D weapons had to be considered differently from current weapons, because in many cases, kill probabilities against the targets considered here are not yet known for these weapons, so these weapons are discussed qualitatively in terms of estimated performance.

402. (C) Current Weapon Descriptions

a. Mk 81 Low Drag General Purpose Bomb. The Mk 81 LDGP bomb has a long slender body with a pointed nose. Fitted with a conical type fin, the bomb is 74.1 inches long, has a maximum body diameter of 9.0 inches, and weighs 260 pounds. The bomb can be fitted with proximity, mechanical, or electrical fuzes (AV-8A is not compatible with electric fuzing) and contains 96 pounds of explosive. Primary kill mechanism is blast and fragments.

b. Mk 82 Low Drag General Purpose Bomb. The Mk 82 LDGP bomb is constructed similar to the Mk 81; however, it is 86.9 inches long, weighs 531 pounds, and has a maximum body diameter of 10.75 inches. The bomb contains 192 pounds of explosive. As with the Mk 81, the primary kill mechanisms are blast and fragments.

c. Mk 83 Low Drag General Purpose Bomb. The Mk 83 LDGP bomb is similar to the Mk 81 and Mk 82, but it is 118 inches long, weighs 985 pounds, and has a maximum body diameter of 14 inches. Explosive weight in the Mk 83 is 416 pounds. The primary kill mechanisms are blast and fragments.

d. Mk 81 Snakeye. The Mk 81 Snakeye is essentially the Mk 81 LDGP bomb fitted with a retardation device to allow both low level release and more favorable weapon orientation on detonation. With the Snakeye fin assembly, the bomb is 75.1 inches long, 9.0 inches in diameter, weighs 301 pounds, and has the same 96 pounds of explosive as the Mk 81 LDGP.

e. Mk 82 Snakeye. The remarks made for the Mk 81 Snakeye also apply to the Mk 82 Snakeye. With the Snakeye fin assembly, the weapon is 92.7 inches long, weighs 560

[redacted]

[redacted]

TABLE G-4-1. (C) CURRENT WEAPONS CONSIDERED FOR AV-8A

Weapon Type	Nomenclature
Low Drag General Purpose Bombs	Mk 81, Mk 82, Mk 83
Retarded Bombs	Mk 81 Snakeye, Mk 82 Snakeye
Firebombs	Mk 77
Rockets	LAU-10A/A (Pod of 4 Zuni Rockets) LAU-69A/A (Pod of 19 2.75-Inch Rockets)
Dispenser Weapons	Rockeye II, CBU-55/B (Low Speed Fuel Air Explosive)
Guns	Aden 30mm
Missiles	Shrike, Sidewinder

TABLE G-4-2. (C) R&D WEAPONS CONSIDERED FOR AV-8A

Weapon Type	Nomenclature
General Purpose Bombs	Advanced General Purpose Bombs (including retarded versions, will eventually replace the Mk 80 series GP bombs).
Dispenser Weapons	Anti-Personnel, Anti-Material Bomblet (APAM) Advanced Incendiary High Speed Fuel Air Explosive
Laser Guided Weapons	Bulldog Laser Guided Bombs
Missiles	Harpoon, Maverick

[redacted]





[redacted]

pounds, has 10.75-inch body diameter, and contains the same 192 pounds of explosive as the Mk 82.

f. Mk 77 Firebomb. The Mk 77 Mod 1 firebomb is a cylindrical aluminum alloy tank with aerodynamically shaped ends. It is 109 inches long, 19 inches in diameter, and weighs approximately 520 pounds fully assembled. The tank is normally filled with a gasoline gel mixture. Igniters and fuzes are used in both the nose and the tail.

g. Zuni Rocket. Zuni is an air-to-ground aircraft rocket whose primary roles are flak suppression, antitank, and general purpose. Zuni rockets can be fired either singly or "rippled." The Zuni is 5 inches in diameter, 110 inches long, and has a firing range of 4,000 to 6,000 feet. An LAU-10A/A launcher weighs 545 pounds when loaded with four completely assembled Zuni's. Several different warheads are available for the Zuni rocket:

(1) The Mk 24 Mod 0 is a general-purpose warhead weighing 48 pounds and containing 9.5 pounds of explosive.

(2) The Mk 32 Mod 0 is a shaped-charge, fragmenting warhead. It weighs 48 pounds and contains 15 pounds of explosive. This warhead is designed for armored targets.

(3) The Mk 63 Mod 0 is a variable change-to-metal antipersonnel warhead. This warhead is fitted with a Mk 93 VT noze fuze which is designed to detonate approximately 18 feet above the ground. This weapon is designed primarily as an antipersonnel flak-suppression rocket. This warhead weighs 48 pounds and contains 14 pounds of explosive.

h. 2.75-Inch Folding-Fin Aircraft Rocket (FFAR). The 2.75-inch FFAR is an air-to-ground weapon used for flak suppression and destruction of soft targets. This rocket is assembled in seven (LAU-78A) or 19 (LAU-69A) round launchers. The rockets have two types of warheads; the Mk 1 is a high explosive warhead, and the Mk 5 is a shaped charge warhead.

i. Rockeye II. The primary purpose of this cluster weapon is the destruction of hard armored targets (tanks, armored vehicles, and guns). The weapon is also effective against softer targets such as parked aircraft and personnel. The cargo of 247 Mk 118 Mod 0 bomblets arm individually and detonate on impact with a hard surface. The bomblets have shaped-charge warheads that will penetrate up to 8.1 inches of armor. The characteristics of Rockeye II and the Mk 118 Mod 0 bomblet are as follows:

[redacted]





[redacted]

Rockeye II

Length, inches	92.1
Diameter, inches	13.2
Weight, pounds	490
Payload	M118 Mod 0 Bomblet (247 each)

M118 Mod 0 Bomblet

Length, inches	13.5
Diameter, inches	2.1
Weight, pounds	1.32
Explosive Charge, g	180
Warhead	Shaped Charge

j. CBU-55/B Low-Speed Fuel Air Explosive Weapon. The purpose of the Fuel Air Explosive (FAE) weapon is to provide a blast damage mechanism that is effective against targets of limited vulnerability to conventional munitions, such as troops in protected and concealed environments, land mines, boobytraps, and light material targets. CBU-55/B consists of an SUU-49/B dispenser containing three contact-fuzed, fuel-air explosive bombs. The characteristics of the weapon are given below:

Length, inches	85
Diameter, inches	14
Weight, pounds	500
No. Bombs in Dispenser	3
Fuel Weight per Bomb, pounds	75
Cloud Diameter per Bomb, feet	50

k. Aden 30mm Gun. The gun system on the AV-8A consists of two electrically fired 30mm Aden cannons which are mounted, together with their ammunition, in external pods on each side of the centerline pylon beneath the fuselage. Each pod, complete with gun and 130 rounds of ammunition, weighs 450 pounds. The 30mm projectile weighs 0.56 pound and the rate of fire from a single gun is 1,200 rounds per minute. Muzzle velocity is 2,500 feet/second.

l. Shrike. The purpose of the AGM-45R Shrike missile is to suppress or destroy enemy radar installations. While captive, the missile furnishes guidance information to the pilot through an aircraft indicator or display system. A tone of frequency equal to the target radar pulse repetition frequency (PRF) is furnished to the pilot for target recognition. Weapon release is accomplished either by manual firing

[redacted]

[redacted]

or by use of a weapon release computer. There are various modes of Shrike which are designed to home on different radar frequencies. The characteristics of Shrike are listed below:

Length, inches	120
Diameter, inches	8
Weight, pounds	400
Payload (HE Frag Warhead), pounds	145
Guidance	Passive Radar Homing
Propulstion	Solid Propellant
Range	3-25 nautical miles

m. Sidewinder. The AIM-9 Sidewinder is an infrared-guided air-to-air missile designed to destroy enemy aircraft. There are several versions (mods) of Sidewinder in the Fleet. The characteristics presented here are for the AIM-9D:

Length, inches	113
Diameter, inches	5
Weight, pounds	195
Warhead, pounds	25 (HE), Continuous Rod
Guidance	Passive IR Homing
Propulstion	Solid Propellant Rocket
Minimum Range (Tail On)	1,000 feet
Maximum Range (Co-Speed, Co-Altitude)	8,500 feet

403. (C) R&D Weapon Descriptions

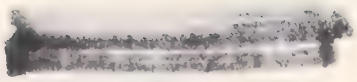
a. Advanced General Purpose Bombs (AGPB). This family of bombs is being developed for improved rearming rates, mission flexibility, and logistics. The weapon will be used to destroy a wide spectrum of targets and will be particularly effective against area-distributed hard targets and targets which can be destroyed by fragmentation or cratering. The AGPB family is scheduled to replace the present Mk 80 series bombs. Precise specifications are still unknown, but as described in the TAAS, an advanced GP bomb family should contain the following three weapons:

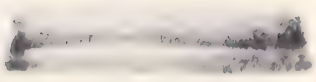
(1) A fragmentation warhead in the 500-pound class, capable of penetrating 8 inches of reinforced concrete.

(2) A moderate penetrator in the 1,000-pound class, capable of penetrating 3 feet of reinforced concrete runway (or aircraft shelters) or the deck of a DLG-type ship.

(3) A 2,000-pound class demolition (blast) bomb for use against ships.

[redacted]





[redacted]

b. Anti-Personnel, Anti-Material (APAM) Cluster Weapon. The APAM weapon is a cluster bomb of the 750-pound category and consists of the Mk 7 Mod 0 dispenser, fuze, and a payload of 761 target discriminating bomblets. The weapon is 13.2 inches in diameter, 91 inches long, and will be effective primarily against a range of targets from personnel through light tanks. Upon impacting a soft target, the bomblets pop up 3 to 10 feet and air burst, thereby maximizing anti-personnel lethality. Upon impacting a hard target, an instantaneous shaped carge function occurs, thereby maximizing anti-material lethality.

c. Advanced Incendiary Weapon. The advanced incendiary weapon is being designed to destroy a wide variety of targets characterized by a combustible structure and/or combustible components. The weapon will be a cluster weapon as most targets for incendiary weapons are area-type targets. The weapon will be in the 500-pound class, 91.3 inches long, and 13.2 inches in diameter.

d. High Speed Fuel Air Explosive. This weapon is similar to Low Speed FAE (CBU-55/B) but is designed to be delivered at higher speeds. The weapon is capable of countering personnel under cover (shielded from fragmentation weapons) or concealment and provides defoliation and mine-clearing capabilities. The characteristics are:

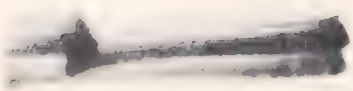
Weight, pounds	525
Length, inches	92
Diameter, inches	14
No. Bombs in Dispenser	3
Weight per Bomb, pounds	130
Cloud Diameter per Bomb, feet	50
Delivery Velocity (max), Knots, IAS	600

e. Bulldog. Bulldog is a Bullpup missile modified to home on reflected laser emissions and does not retain the command guidance of Bullpup. The design characteristics are as follows:

Guidance	Semi-Active Laser Homing
Warhead	250-pound (Bullpup A)
Propulsion	Liquid (Bullpup A Motor)
Accuracy	10-foot CEP
Slant Range	5,000 to 30,000 feet
Weight, pounds	600
Length, inches	117
Diameter, inches	12

[redacted]





[redacted]

f. Harpoon. Harpoon is an air-to-surface missile currently in R&D. It is being designed as an all-weather, active-homing, shp attack missile. Only "ball park" figures can be stated here, and these characteristics are by no means to be considered the final design specifications:

Weight, pounds	1,200 (nominal)
Warhead Weight, pounds	400-600 (nominal)
Guidance	Active Radar (probable)
Range, nautical miles (max)	30 (nominal)

g. Maverick. The AGM-65A Maverick is an air-to-ground, Electro-Optical/TV-guided (EO/TV), rocket-propelled missile. The EO/TV guidance system is desinged to home on target contrast. Primary targets are tanks, armored personnel carriers, field fortifications, and reinforced buildings. The weapon has the following characteristics:

Weight, pounds	500 (nominal)
Length, inches	98
Diameter, inches	12
Guidance	Electro-Optical TV
Propulsion	Solid Propellant Rocket Motor
Warhead	Shaped Charge, 125 pounds
Range	3,000 feet to 14 nautical miles

[redacted]





[redacted]

SECTION 5. ORDNANCE CAPACITY AND DELIVERY ACCURACY OF THE AV-8A

501. (C) Ordnance Capacity

a. There are many variables that will interact to determine the AV-8A's ordnance capacity on a particular mission such as the amount of take-off run available, the velocity and direction of wind, and the mission radius. Obviously, the number of combinations of all factors provides a virtual continuum of possible loads for the AV-8A. To keep within manageable bounds, two discrete values were selected to provide an indication of performance under varying conditions. The take-off conditions selected were vertical and a 600-foot take-off run. Take-off runs greater than 600 feet were not investigated since most ordnance is store limited at the 600-foot take-off run. For the vertical take-off, a 50-nautical mile distance to the target was assumed, with 5 minutes on target and a 50 nautical mile return flight. In the other case, 600-foot take-off, a 100-nautical mile mission radius with 5 minutes on target was assumed. The ordnance capacities for missions are shown in Table G-5-1.

TABLE G-5-1. (U) MISSION CONDITIONS AND ORDNANCE CAPACITY FOR THE AV-8A

Mission Description	Ordnance Capacity
Vertical take-off, 50-nautical mile leg to target, 5 minutes on target, 50-nautical mile return leg.	3,000 pounds.
600-foot take-off run, 100-nautical mile leg to target, 5 minutes on target, 100-nautical mile return leg.	4,700 pounds

b. Additional conditions on ordnance capacity were imposed by weapon station limitations, stability and weight limitations, aircraft wiring, and length and clearance limitations. As discussed in reference 9, the Aircrew Manual, for combat maneuvers of 7.0 g's, the weight limitations were assumed to be 600 pounds on the outboard wing stations and 1,100 pounds on the inboard wing stations and on the centerline station. If the combat maneuvers are restricted to 4.0 g's, then the outboard wing stations will support 1,000 pounds; the inboard wing stations and centerline stations will support 2,000 pounds. The 7.0 g combat maneuver is assumed.

[redacted]





[redacted]

c. The Mk 83 1,000-pound GP bomb cannot be loaded on the centerline due to its length. Rocket pods cannot be loaded on the centerline because that station is not wired to provide a firing pulse for rockets. These are the main restrictions; others will be mentioned in the discussion of weapon selection.

d. Although multiple weapon racks have not yet been approved for the AV-8A, it was assumed that a rack, providing a capability of two weapons at each wing station (within weight limitations) will be available.

e. Finally, the discussion is limited to weapons with 14-inch suspension. This restriction excludes the Mk 84 2,000-pound GP bomb. In all cases, the AV-8A must be loaded symmetrically.

502. (C) Delivery Accuracy

a. The AV-8A has the Ferranti, Ltd. FE-541 Inertial Navigation/Attack System installed in it. The purpose of this discussion is not to go into the details of this system as it is adequately covered in existing publications. Briefly, the system is a fully integrated complement of avionics equipment. Its purpose is to provide navigation to and from a selected destination, and to provide weapon aiming and release signals for delivery of a wide variety of ordnance against both ground and air targets.

b. Since only time and experience will determine the actual combat accuracy of the system, it was decided to include weapon kill probabilities for the CP-741 bombing system, as well as for a 10-mil system. It is felt that the FE-541 accuracy will be better than the CP-741 accuracy and perhaps as good as a 10-mil system, but since the precise accuracy is yet to be determined, this discussion will use the two sets of accuracies as reasonable limits. Table G-5-2 shows the accuracy and ballistic dispersions of the two systems.

c. Air-to-ground gun attacks are primarily a problem of pointing the aircraft properly, not pointing its velocity vector properly, the latter a more difficult computational task. Since the actual accuracy is not known, this report presents two systems accuracies for rockets. The parameters for these accuracies are also shown in Table G-5-2.

d. In the air-to-air gun attack mode, stadiametric ranging is used to obtain both range and rate-of-change of range. This could present considerable problems and could well be unusable. Further study of the air-to-air gun mode is recommended.

[redacted]

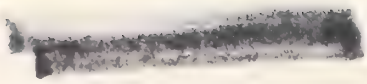




TABLE G-5-2. (C) ACCURACY AND BALLISTIC DISPERSION INPUTS

AIMING ERRORS, ON GROUND, FEET

	Delivery Conditions, Dive Angle, and Release Altitude			
	45° 5,500 Feet	30° 3,000 Feet	20° 2,000 Feet	10° 500 Feet
Bombs:				
CP-741, VX-5 Accuracy				
$\sigma_d = \sigma_r$	170	136	85	59
CEP	200	160	100	70
10-Mil Combat System				
σ_d	59	42	37	17
σ_r	70	62	70	44
CEP	75	60	60	32
Rockets:				
Iron Sight, VX-5 Accuracy				
9-Mil System				
$\sigma_d = \sigma_r$	153	127	77	51
CEP	180	150	90	60
5-Mil System				
σ_d	32	25	24	12
σ_r	46	50	70	64
CEP	45	42	48	33





[redacted]

SECTION 6. WEAPON EFFECTIVENESS (U)

601. (C) General. Kill probabilities (P_k's) from TAAS were used to generate the effectiveness numbers presented in the tables in this section. P_k numbers were available for Mk 81, Mk 82, Mk 81 Snakeye, Mk 82 Snakeye, Mk 83, Mk 77 Firebomb, Zuni, 2.75-Inch FFAR, and Rockeye II. For some targets, P_k's were available for APAM, Zuni with the Mk 63 VCMR warhead, and Bulldog. P_k represents the probability of achieving the kill criteria described in Section 3 for each target.

602. (C) P_k Calculations. In TAAS the ordnance loads were selected for the A-4, A-6, and A-7 aircraft. Consequently, the P_k numbers were given for a range which included large numbers of weapons which cannot be carried by the AV-8A (12 or 18 Mk 82 bombs). In order to determine the P_k numbers for the loads compatible with AV-8A (2, 4, 5, 7 Mk 82 bombs), curves had to be drawn for the TAAS numbers, and extrapolations and interpolations were made from extensions of these curves. Thus the majority of the numbers presented here are extrapolations. Because of the additive effects of multiple weapons, numbers so generated are likely to be optimistic. It is not recommended that the P_k data be used to estimate sortie requirements. These numbers should be used only to note the relative effectiveness of the various weapons.

603. (C) Delivery Accuracy. As noted in Section 5 of this annex, P_k data were generated for both a 10-mil system and the CP-741 computer system. For the majority of cases, both sets of numbers were available. In some cases, however, data were not available for either system accuracy (notably for troops). In these cases, data are presented for the most representative accuracy available. In most cases, these are for iron sight accuracy. The P_k tables in this section indicate the effectiveness of the weapons for the different accuracies side-by-side for comparison when both are available.

604. (C) Delivery Conditions. The delivery conditions for which the P_k numbers are presented represent four conditions in the entire spectrum of possible conditions. Those used are all for 450 knots TAS and for the following four dive angles/release altitudes: 45 degrees/5,500 feet, 30 degrees/3,000 feet, 20 degrees/2,000 feet, and 10 degrees/500 feet. These conditions are the ones for which data were available from TAAS. Although it is recognized that release angles will vary from 0 degrees to 60 degrees and other release altitudes may be used, the tactics for which data are presented adequately represent the entire spectrum of possible tactics and are enough to indicate weapon selection trends.

[redacted]

[redacted]

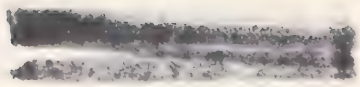
605. (U) Ordnance Loads. The P_k tables present effectiveness numbers for sticks of several different numbers for each weapon, with the exception of Bulldog P_k's which are always for a single missile.

606. (U) P_k Tables. Tables G-6-2 to G-6-28 represent the data on which the weapons selections made in Section 7 of this annex are based. For convenience, Table G-6-1 is a reference table to allow the reader to locate quickly the P_k tables for particular targets. In the cases where data were not available, a "-" appears in the tables. If a particular delivery condition is not usually employed with a weapon, an "NA" appears in the tables.

TABLE G-6-1. (U) TABLE OF CONTENTS FOR WEAPON/TARGET P_k TABLES

Target, Kill Criterion	Table	Page No.
Prone Troops, 5-Minute Assault		
150 x 300 Foot Area	G-6-2	G-29
100 x 1,000 Foot Area	G-6-3	G-30
1,000 x 1,000 Foot Area	G-6-4	G-31
Troops in Foxholes, 20-Second Defense		
150 x 300 Foot Area	G-6-5	G-32
100 x 1,000 Foot Area	G-6-6	G-33
1,000 x 1,000 Foot Area	G-6-7	G-34
Small Weapon Position, Crew Out of Action	G-6-8	G-35
Truck, K-Kill	G-6-9	G-36
Truck, M-Kill, A-Category	G-6-10	G-37
Truck Park, K-Kill	G-6-11	G-38
Tank, K-Kill	G-6-12	G-39
Tank, M-, F-, or K-Kill	G-6-13	G-40
Tank Column, K-Kill	G-6-14	G-41
Tank Column, M-, F-, or K-Kill	G-6-15	G-42
Armored Personnel Carrier, M- or P-Kill	G-6-16	G-43
Gas Cache, Destroy	G-6-17	G-44
Ammo Cache, Destroy	G-6-18	G-45
Diesel Fuel Cache, Destroy	G-6-19	G-46
Bunker, Collapse	G-6-20	G-47
Pillbox, Collapse	G-6-21	G-48
Hardened Cave, Collapse	G-6-22	G-49
Wooden Bridge, Drop	G-6-23	G-50
Steel Truss Bridge, Drop Span	G-6-24	G-51
Building, Collapse	G-6-25	G-52
Flak Site, Suppress	G-6-26	G-53
Komar, Sink	G-6-27	G-54
WBLC, Sink	G-6-28	G-55

[redacted]





CONFIDENTIAL

TABLE G-6-2. (C) WEAPON EFFECTIVENESS

TARGET: Prone Troops 150 x 300 ft. CRITERION: 5 min Assault 1/

WEAPON	No.	45°/3500 FT IRON-SIGHT	45°/3500 FT CP 741	45°/3500 FT 10 M11	30°/3000 FT IRON-SIGHT	30°/3000 FT CP 741	30°/3000 FT 10 M11	20°/2000 FT IRON-SIGHT	20°/2000 FT CP 741	20°/2000 FT 10 M11	10°/500 FT IRON-SIGHT	10°/500 FT CP 741	10°/500 FT 10 M11
MK 81	2 4 6 8	.08 .15 .19 .22	-	-	.09 .16 .23 .27	-	-	.17 .29 .35 .36	-	-	NA	NA	NA
MK 81SE	2 4 6 8	NA	NA	NA	NA	NA	NA	NA	NA	NA	.18 .33 .46 .56	-	-
MK 82	2 4 6 7	.12 .21 .26 .28	-	-	.10 .20 .27 .30	-	-	.21 .34 .42 .45	-	-	NA	NA	NA
MK 82SE	2 4 6 7	NA	NA	NA	NA	NA	NA	NA	NA	NA	.22 .42 .57 .64	-	-
MK 83	1 2 3 4	.05 .15 .20 .24	-	-	[illegible]			.16 [illegible] .33 [illegible]	-	-	NA	NA	NA
MK 77 FIREBOMB	2 4 6 7	NA	NA	NA	[illegible]			[illegible]	NA	NA	.17 .29 .36 .39	-	-
ROCKEYE	1 2 4 6	-	.25 .33 .50 .53	.36 .54 .81 .87	-	-	-	-	.32 .53 .76 .82	.54 .75 .93 .96	-	-	-
ZUNI PODS MK 32	2 4 6	.01 .04 .08	-	-	.04 .07 .10	-	-	.03 .08 .09	-	-	NA	NA	NA
ZUNI PODS MK 83	2 4 6	.35 .41	-	[illegible]	[illegible]	-	[illegible]	[illegible]	-	[illegible]	NA	NA	NA
2.75" PODS M151	2 4 6	.01 .03 .06	-	-	[illegible]			[illegible]	-	-	NA	NA	NA

WEAPON		45°/5500 FT CP 741 Pattern Radius 100 FT	45°/5500 FT CP 741 Pattern Radius 200 FT	45°/5500 FT 10 M11 Pattern Radius 100 FT	45°/5500 FT 10 M11 Pattern Radius 200 FT	20°/2000 FT CP 741 Pattern Radius 91 FT	20°/2000 FT CP 741 Pattern Radius 200 FT	20°/2000 FT 10 M11 Pattern Radius 91 FT	20°/2000 FT 10 M11 Pattern Radius 191 FT
APAM I NON-POP-UP	1 2 3	.18 .32 .43	.45 .65 .74	.37 .[illegible] .78	.66 .86 .93	.37 .45 .58	.[illegible] .72 .85	.46 .70 .83	.64 .91 .95
APAM I POP-UP	1 2 3	.24 .37 .45	.43 .63 .76	.36 .57 .71	.68 .80 .95	.41 .55 .69	.64 .81 .[illegible]	.48 .68 .85	.63 .92 .97

BULLDOG CEP	45°/[illegible] FT	30°/3000 FT
10 FT	.23	.20
25 FT	.23	.22

NOTES: 1/ P_k numbers represent the percentage of the total number of troops in the area that suffer the stated kill (K1) level. Troops are assumed to be uniformly distributed throughout the area.

2/ P_k numbers are for a 5-mil forward [illegible]

CONFIDENTIAL

[redacted]

TABLE G-6- 3. (C) WEAPON EFFECTIVENESS

TARGET: Prone Troops 100 x 1,000 ft. CRITERION: 5 min. Assault 1/

WEAPON	NO.	45°/5500 FT			30°/3000 FT			20°/2000 FT			10°/500 FT		
		IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL
MK 81	2	.04	-	-	.05	-	-	.08	-	-	NA	NA	NA
	4	.07			.09			.16					
	6	.11			.13			.21					
	8	.15			.16			.26					
MK 81SE	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	.09	NA	NA
	4										.18		
	6										.27		
	8										.35		
MK 82	2	.09	-	-	.07	-	-	.09	-	-	NA	NA	NA
	4	.13			.14			.16					
	6	.18			.20			.24					
	7	.20			.22			.26					
MK 82SE	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	.14	-	-
	4										.26		
	6										.36		
	7										.41		
MK 83	1	.05	-	-	.05	-	-	.05	-	-	NA	NA	NA
	2	.09			.10			.15					
	3	.13			.14			.19					
	4	.17			.18			.20					
MK 77 FIREBOMB	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	.06	-	-
	4										.12		
	6										.17		
	7										.20		
ROCKEYE	1	-	.11	.17	-	-	-	-	.17	.19	-	-	-
	2		.20	.30					.29	.33			
	4		.36	.53					.47	.54			
	6		.48	.65					.57	.68			
ZUNI PODS MK 32	2	.02	-	-	.02	-	-	.02	-	-	NA	NA	NA
	4	.03			.04			.04					
	6	.04			.05			.06					
ZUNI PODS MK 63	2	-	-	-	-	-	-	-	-	-	-	-	-
	4												
	6												
2.75" PODS M151	2	.005	-	-	.01	-	-	.01	-	-	NA	NA	NA
	4	.01			.02			.02					
	6	.02			.03			.04					

WEAPON		45°/5500 FT				20°/2000 FT			
		CP 741		10 MIL		CP 741		10 MIL	
		Pattern Radius		Pattern Radius		Pattern Radius		Pattern Radius	
		103 FT	206 FT	103 FT	206 FT	95 FT	190 FT	95 FT	190 FT
APAM I NON-POP-UP	1	.10	.26	.14	.28	.15	.35	.1-	.41
	2	.18	.42	.26	.46	.26	.52	.29	.58
	3	.26	.54	.36	.61	.36	.64	.41	.75
APAM I POP-UP	1	.10	.22	.15	.32	.15	.27	.1-	.31
	2	.19	.39	.27	.50	.27	.46	.3-	.51
	3	.27	.62	.37	.65	.37	.61	.4-	.66

BULLDOG CEP	45°/8000 FT	30°/3000 FT
10 FT	.06	.08
25 FT	.09	.09

NOTE: 1/ P_k numbers represent the percentage of the total number of troops in the area that suffer the 5-min assault kill. Troops are assumed to be uniformly distributed throughout the area.

[redacted]

[redacted]

TABLE G-A- 4. (C) WEAPON EFFECTIVENESS

TARGET: Prone Troops 1,000 x 1,000 ft. CRITERION: 5 min. Assault 1/

WEAPON	No.	45°/5000 FT			30°/3000 FT			20°/2000 FT			10°/500 FT		
		IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL
MK 81	2	.025	-	-	.025	-	-	.020	-	-	NA	NA	NA
	4	.047			.048			.040					
	6	.070			.076			.060					
	8	.090			.092			.080					
MK 81SE	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	.026	-	-
	4										.050		
	6										.070		
	8										.090		
MK 82	2	.042	-	-	.033	-	-	.040			NA	NA	NA
	4	.080			.072			.077					
	6	.110			.110			.096					
	7	.123			.125			.115					
MK 82SE	2	NA	NA	NA	NA	NA	NA	NA	-	NA	.032	-	-
	4										.060		
	6										.090		
	7										.106		
MK 83	1	.033	-	-	.027	-	-	.024	-	-	NA	NA	NA
	2	.065			.060			.056					
	3	.087			.092			.079					
	4	.105			.117			.097					
MK 77 FIREBOMB	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	.017	-	-
	4										.034		
	6										.050		
	7										.057		
ROCKEYE	1	-	.04	.03	-	-	-	-	.05	.05	-	-	-
	2		.09	.09					.09	.09			
	4		.15	.16					.15	.15			
	6		.19	.20					.19	.19			
ZUNI PODS MK 32	2	.004	-	-	.004	-	-	.003	-	-	NA	NA	NA
	4	.010			.010			.008					
	6	.020			.020			.015					
ZUNI PODS MK 63	2			-	-	-	-		-	-	NA	NA	NA
	4												
	6												
2.75" PODS M151	2	.003	-	-	.003	-	-	.004	-	-	NA	NA	NA
	4	.006			.006			.007					
	6	.014			.014			.011					

WEAPON	No.	45°/5000 FT				20°/2000 FT			
		CP 741		10 MIL		CP 741		10 MIL	
		Pattern Radius		Pattern Radius		Pattern Radius		Pattern Radius	
		103 FT	206 FT	103 FT	206 FT	95 FT	190 FT	95 FT	190 FT
APAM I NON-POP-UP	1	.04	.11	.04	.13	.04	.14	.04	.10
	2	.07	.20	.06	.21	.08	.22	.06	.21
	3	.10	.26	.11	.27	.11	.26	.11	.29
APAM I POP-UP	1	.04	.11	.05	.12	.05	.15	.04	.16
	2	.07	.20	.08	.23	.09	.24	.06	.25
	3	.10	.27	.11	.27	.12	.2[illegible]	.11	.31

BULLDOG CEP	45°/6000 FT	10°/3000 FT
10 FT	.02	.02
25 FT	.02	.02

NOTE: 1/ Numbers represent the percentage of the [illegible] troops in the area [illegible] for a mid-assault kill. [illegible] to be lethally wounded.

[redacted]

[redacted]

TABLE G-6-5. (C) WEAPON EFFECTIVENESS

TARGET: Troops in Foxholes 150 x 300 ft. CRITERION: 90 Sec. Defense

WEAPON	NO.	45°/5500 FT			30°/3000 FT			20°/2000 FT			10°/500 FT		
		IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL
MK 81	2	.008	-	-	.014	-	-	.01	-	-	NA	NA	NA
	4	.014			.024			.02					
	6	.020			.029			.03					
	8	.025			.033			.04					
MK 81SE	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	.042	-	-
	4										.072		
	6										.092		
	8										.105		
MK 82	2	.005	-	-	.010	-	-	.01	-	-	NA	NA	NA
	4	.012			.020			.02					
	6	.020			.030			.03					
	7	.027			.044			.04					
MK 82SE	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	.091	-	-
	4										.133		
	6										.172		
	7										.196		
MK 83	1	.019	-	-	.031	-	-	.03	-	-	NA	NA	NA
	2	.031			.051			.05					
	3	.040			.066			.06					
	4	.046			.076			.07					
MK 77 FIREBOMB	2										.026		
	4	NA	NA	NA	-	-	NA	NA	NA	NA	.043	-	-
	6										.054		
	7										.058		
ROCKEYE	1	-	.01	.02	-	-	-	.01	.02	.02	-	-	-
	2		.02	.03				.02	.03	.03			
	4		.03	.04				.03	.04	.04			
	6		.03	.04				.03	.04	.04			
ZUNI PODS MK 32	2	.014	-	-	.024	-	-	.02	-	-	NA	NA	NA
	4	.030			.054			.05					
	6	.060			.104			.10					
ZUNI PODS MK 63	2	.12			.21			.20			NA	NA	NA
	4	.20			.37			.36					
	6												
2.75" PODS M151	2	.004	-	-	.007	-	-	.01	-	-	NA	NA	NA
	4	.010			.018			.02					
	6	.020			.035			.03					

WEAPON	NO.	45°/5500 FT		30°/3000 FT		20°/2000 FT		10°/500 FT	
		CP 741 Pattern Radius	10 MIL Pattern Radius	CP 741 Pattern Radius	10 MIL Pattern Radius	CP 741 Pattern Radius	10 MIL Pattern Radius	CP 741 Pattern Radius	10 MIL Pattern Radius
		100 FT	200 FT	100 FT	200 FT	100 FT	200 FT	100 FT	200 FT
APAM I NON-POP-UP	1	.03	.07	.08	.14	.07	.12	.08	.13
	2	.06	.13	.14	.24	.12	.21	.14	.23
	3	.09	.19	.19	.33	.17	.29	.19	.32
APAM I POP-UP	1	.09	.17	.21	.37	.19	.32	.21	.35
	2	.18	.34	.39	.67	.34	.58	.38	.63
	3	.25	.50	.57	.96	.49	.83	.54	.90

BULLDOG CEP	45°/8000 FT	30°/5000 FT
10 FT	.04	.07
25 FT	.04	.07

[redacted]

[redacted]





CONFIDENTIAL

TABLE G-E-6. (C) [illegible]

TARGET: Troops in Footholes 100 x 1,000 ft. CRITERION: 30 Sec. Defense[1/]

WEAPON	No.	45°/5500 FT			30°/3000 FT			20°/2000 FT			10°/500 FT		
		IRON-SIGHT	CP 741	10 M11	IRON-SIGHT	CP 741	10 M11	IRON-SIGHT	CP 741	10 M11	IRON-SIGHT	CP 741	10 M11
MK 81	2	.003	-	-	.003	-	-	.008	-	-	NA	NA	NA
	4	.007			.007			.015					
	6	.010			.010			.020					
	8	.013			.013			.023					
MK 81SE	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	.012	-	-
	4										.020		
	6										.024		
	8										.026		
MK 82	2	.007	-	-	.007	-	-	.010	-	-	NA	NA	NA
	4	.013			.014			.020					
	6	.020			.020			.024					
	7	.023			.024			.027					
MK 82SE	3										.025		
	4	NA	NA	NA	NA	NA	NA	NA	NA	NA	.040	-	-
	6										.060		
	7										.067		
MK 83	1	.006			[illegible]			[illegible]					
	2	.013	-	-	[illegible]	-	-	.028	-	-	NA	NA	NA
	3	.020			[illegible]			[illegible]					
	4	.031			[illegible]			[illegible]					
MK 77 FIREBOMB	2	[illegible]									.010		
	4										.019	-	-
	6										.027		
	7										.030		
ROCKEYE	1	-	.01	.01	[illegible]			.01	.01		-	-	-
	2		.01	.01				.02	.02				
	4		.02	.02				.03	.03				
	6		.03	.03				.05	.05				
ZUNI PODS MK 32	2	.01	-	-	[illegible]	-	-	[illegible]	-	-	NA	NA	NA
	4	.02			[illegible]			[illegible]					
	6	.03			[illegible]			[illegible]					
ZUNI PODS MK 63	2	-	-	-	-	-	-	-	-	-	NA	NA	NA
	4												
	6												
2.75" PODS M151	2	.001	-	-	[illegible]	-	-	[illegible]	-	-	NA	NA	NA
	4	.004			[illegible]			[illegible]					
	6	.010			[illegible]			[illegible]					

WEAPON	No.	45°/5500 FT				30°/3000 FT			
		CP 741 Pattern Radius		10 M11 Pattern Radius		CP 741 Pattern Radius		10 M11 Pattern Radius	
		100 FT	200 FT	100 FT	200 FT	25 FT	100 FT	100 FT	[illegible]
APAM I NON-POP-UP	1	.02	.01	.03	.02	[illegible]	[illegible]	.03	.01
	2	.03	.02	.05	.03	[illegible]	[illegible]	[illegible]	.03
	3	.05	.04	.07	.05	.07	.05	[illegible]	.05
APAM I POP-UP	1	.05	.03	.07	.07	[illegible]	.03	[illegible]	.05
	2	.10	.06	.15	.13	[illegible]	.10	[illegible]	.13
	3	.15	.17	.21	.21	.23	.17	[illegible]	.21

BULLDOG CEP	45°/8000 FT	30°/3000 FT
10 FT	.02	.02
25 FT	.02	[illegible]

NOTE: [illegible] represent the percentage of [illegible] troops in the area [illegible] from the 30-sec defense fill. [illegible] are assumed to be uniformly [illegible] throughout the area.

CONFIDENTIAL





TABLE G-6-7. (C) WEAPON EFFECTIVENESS

TARGET: Troops in Foxholes 1,000 x 1,000 ft. CRITERION: 30 Sec. Defense 1/

WEAPON	No.	45°/5000 FT			30°/3000 FT			25°/2000 FT			10°/500 FT		
		IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL
MK 81	2	.005	-	-	.003	-	-	.003	-	-	NA	NA	NA
	4	.008			.007			.007					
	6	.010			.010			.010					
	8	.010			.010			.013					
MK 81SE	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	-	-
	4												
	6												
	8												
MK 82	2	.005	-	-	.003	-	-	.003	-	-	NA	NA	NA
	4	.008			.007			.007					
	6	.010			.010			.010					
	7	.012			.012			.012					
MK 82SE	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	-	-
	4												
	6												
	7												
Mk 83	1	.006	-	-	.005	-	-	.006	-	-	NA	NA	NA
	2	.009			.014			.006					
	3	.015			.020			.015					
	4	.020			.024			.024					
Mk 77 FIREBOMB	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	-	-
	4												
	6												
	7												
ROCKEYE	1	-	.01	.002	-	-	-	.01	.010	-	-	-	-
	2		.002	.01				.002	.03			.37	.59
	4		.01	.01				.01	.03			.47	.71
	6		.01	.01				.01	.04			-	-
ZUNI PODS MK 32	2	.007	-	-	.007	-	-	.004	-	-	NA	NA	NA
	4	.010			.010			.006					
	6	.010			.012			.012					
ZUNI PODS MK 63	2	-	-	-	-	-	-	-	-	-	NA	NA	NA
	4												
	6												
2.75" PODS M151	2	.001	-	-	.001	-	-	.001	-	-	NA	NA	NA
	4	.002			.002			.002					
	6	.003			.003			.003					

WEAPON		45°/5000 FT				30°/3000 FT			
		CP 741		10 MIL		CP 741		10 MIL	
		Pattern Radius		Pattern Radius		Pattern Radius		Pattern Radius	
		103 FT	206 FT	103 FT	206 FT	95 FT	190 FT	95 FT	190 FT
APAM I NON-POP-UP	1	.01	.01	.01	.04	.00	.01	.01	.01
	2	.01	.01	.01	.02	.01	.02	.01	.02
	3	.02	.02	.02	.02	.01	.02	.01	.02
APAM I POP-UP	1	.02	.03	.02	.03	.03	.04	.02	.04
	2	.04	.05	.04	.06	.05	.07	.05	.07
	3	.05	.07	.05	.09	.07	.10	.06	.09

BULLDOG CEP	45°/8000 FT	30°/3000 FT
10 FT	.002	.002
25 FT	.002	.002

NOTE: 1/ P_k numbers represent the percentage of the total number of troops in the area that suffer the 30-sec defense kill. Fatalities are assumed to be uniformly distributed throughout the area.

TABLE G-6- B. (C) WEAPON EFFECTIVENESS

TARGET: Gun Site 8 Man Crew

CRITERION: Gun Crew Out of Action

WEAPON	No.	45°/5500 FT			30°/3000 FT			20°/2000 FT			10°/500 FT		
		IRON-SIGHT	CP 741	10 M11	IRON-SIGHT	CP 741	10 M11	IRON-SIGHT	CP 741	10 M11	IRON-SIGHT	CP 741	10 M11
MK 81	2 4 6 8	-	-	-	-	-	-	-	-	-	-	-	-
MK 81SE	2 4 6 8	-	-	-	-	-	-	-	-	-	-	-	-
MK 82	2 4 6 7	-	-	-	-	-	-	-	-	-	-	-	-
MK 82SE	2 4 5 7	-	-	-	-	-	-	-	-	-	-	-	-
MK 83	1 2 3 4	-	-	-	-	-	-	-	-	-	-	-	-
MK 77 FIREBOMB	2 4 6 7	-	-	-	-	-	-	-	-	-	-	-	-
ROCKEYE	1 2 4 6	-	-	-	-	-	-	-	-	-	-	-	-
ZUNI PODS MK 32	2 4 6	-	-	-	-	-	-	-	-	-	-	-	-
ZUNI PODS MK 63	2 4 6	-	-	1 .59 6[illegible]	-	-	.4[illegible]			.62 .66 .72	-	-	.75 .84 .87
2.75" PODS M151	2 4 6	-	-		-	-	-	-	-	-	-	-	-

WEAPON	No.	45°/5[illegible] FT				20 FT	
		CP 741 Mk-Burn Radius		10 M11 Pattern Radius			
		300 FT	200 FT	300 FT	200 FT	[illegible] FT	[illegible] FT
APAM I Non-POP-UP	1 2 3	-	-	-	-	-	-
APAM I POP-UP	1 2 3	-	-	-	-		

BULLDOG CEP	45°/8000 FT	[illegible]°/3000 FT
10 FT	-	-
25 FT	-	-

[redacted]

TABLE G-6-9. (C) WEAPON EFFECTIVENESS

TARGET: Truck

CRITERION: K-kill [1]

WEAPON	NO.	45°/5500 FT			35°/3000 FT			20°/2000 FT			10°/500 FT		
		IRON-SIGHT	CP 741	10 M11	IRON-SIGHT	CP 741	10 M11	IRON-SIGHT	CP 741	10 M11	IRON-SIGHT	CP 741	10 M11
MK 81	2	-	.009	.045	-	.011	.075	-	.035	.075	NA	NA	NA
	4		.017	.090		.023	.135		.064	.140			
	6		.024	.133		.034	.183		.087	.190			
	8		.030	.170		.046	.215		.098	.227			
MK 81SE	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	.080	.125
	4											.088	.175
	6											.100	.200
	8											.102	.205
MK 82	2	-	.011	.055	-	.[illegible]	.090	-	.050	.[illegible]	NA	NA	NA
	4		.[illegible]	.[illegible]		.[illegible]	.[illegible]		.[illegible]	.[illegible]			
	6		.033	.[illegible]		.[illegible]	.[illegible]		.[illegible]	.[illegible]			
	7		.037	.[illegible]		.[illegible]	.[illegible]		.[illegible]	.[illegible]			
MK 82SE	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	.091	.160
	4											.125	.245
	6											.140	.270
	7											.142	.272
MK 83	1	-	.013	.[illegible]	-	.[illegible]	.[illegible]	-	.038	.[illegible]	NA	NA	NA
	2		.027	.[illegible]		.[illegible]	.[illegible]		.064	.[illegible]			
	3		.038	.[illegible]		.[illegible]	.[illegible]		.100	.[illegible]			
	4		.047	.[illegible]		.[illegible]	.[illegible]		.130	.[illegible]			
MK 77 FIREBOMB	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	.045	.060
	4											.060	.110
	6											.[illegible]	.[illegible]
	7											.182	.170
ROCKEYE	1	-	.02	.[illegible]	-	.[illegible]	.[illegible]	-	.[illegible]	.[illegible]	-	.25	.55
	2		.[illegible]	.[illegible]		.[illegible]	.[illegible]		.[illegible]	.[illegible]		.38	.76
	4		.[illegible]	.[illegible]		.[illegible]	.[illegible]		.[illegible]	.[illegible]		.48	.90
	6		.12	.3[illegible]		.[illegible]	.[illegible]		.[illegible]	.[illegible]		.50	.95
ZUNI PODS MK 32	2	.002	-	-	.[illegible]	-	-	.[illegible]	-	.[illegible] [2]	NA	NA	NA
	4	.005								.110			
	6	.006			.[illegible]					.[illegible]			
ZUNI PODS MK 63	2	-	-	-	-	-	-	-	-	-	-	-	-
	4												
	6												
2.75" PODS M151	2	.007	-	-	.[illegible]	-	-	.[illegible]	-	.[illegible] [2]	-	-	-
	4	.013			.[illegible]			.[illegible]		.[illegible]			
	6	.019			.[illegible]			.[illegible]		.[illegible]			

Notes: [1] K numbers represent the probability that the truck will be rendered unusable and not feasible to repair.

[2] K numbers are for a 5-mil forward firing accuracy

WEAPON	NO.	45°/5500 FT			35°/3000 FT			20°/2000 FT			10°/500 FT		
		CP 741 Pattern Radius		10 M11 Pattern Radius	CP 741 Pattern Radius		10 M11 Pattern Radius	CP 741 Pattern Radius		10 M11 Pattern Radius	CP 741 Pattern Radius		10 M11 Pattern Radius
		103 FT	206 FT		103 FT	206 FT		95 FT	190 FT		48 FT	96 FT	
APAM I NON-POP-UP	1	.06	.05	.15	.[illegible]	.[illegible]	.[illegible]	.[illegible]	.[illegible]	.[illegible]	.[illegible]	.[illegible]	.[illegible]
	2	.16	.09	.[illegible]	.[illegible]	.[illegible]	.[illegible]	.[illegible]	.[illegible]	.[illegible]	.[illegible]	.[illegible]	.[illegible]
	3	.15	.12	.32	.13	.[illegible]	.[illegible]	.[illegible]	.[illegible]	.[illegible]	.[illegible]	.[illegible]	.[illegible]
APAM I POP-UP	1	-	-		-							-	
	2												
	3												

BULLDOG CEP	45°/6000 FT	35°/3000 FT
10 FT	.63	.42
25 FT	.17	.12

[redacted]

TABLE G-F-10. (C) WEAPON EFFECTIVENESS

TARGET: Truck

CRITERION: M-K111, A-Category 1/

WEAPON	NO.	45°/5500 FT			30°/3500 FT			20°/2500 FT			10°/500 FT		
		IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL
MK 81	2	-	.04	.20	-	.04	.20	-	.08	.18	NA	NA	NA
	4		.07	.33		.07	.34		.16	.32			
	6		.10	.42		.10	.43		.23	.41			
	8		.12	.48		.12	.50		.28	.48			
MK 81SE	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	.15	.25
	4											.23	.42
	6											.27	.45
	8											.28	.455
MK 82	2	-	.06	.28	-	.06	.27	-	.16	.26	NA	NA	NA
	4		.11	.43		.10	.44		.25	.41			
	6		.15	.52		.13	.53		.32	.51			
	7		.17	.56		.15	.55		.32	.54			
MK 82SE	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	.24	.30
	4											.34	.51
	6											.36	.53
	7											.38	.52
MK 83	1	-	.06	.23	-	.07	.23	-	.13	-	NA	NA	NA
	2		.10	.34		.10	.33		.24				
	3		.14	.4		.1	.4		.3	.4			
	4		.17	.54		.1	.5		.3	.5			
MK 77 FIREBOMB	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	.11	.15
	4											.20	.21
	6											.28	.24
	7											.32	.30
ROCKEYE	1	-	.05	.21	-	.08	-	-	.1	.21	-	.27	.59
	2		.11	.38		.1			.2	.2		.40	.61
	4		.16	.51		.2			.2	.3		.45	.93
	6		.23	.64		.2			.3	.3		.45	.97
ZUNI PODS MK 32	2	.033	-	-	.02	-	-	.0	-	-	NA	NA	NA
	4	.063			.0			.1					
	6	.089						.1					
ZUNI PODS MK 63	2	-	-	-	-	-	-	-	-	-	-	-	-
	4												
	6												
2.75" PODS M151	2	.080	-	-	.11	-	-	.1	-	-	NA	NA	NA
	4	.140			.19			.2					
	6	.188			.2			.3					

WEAPON	NO.	45°/5500 FT			20°/2500 FT		
		CP 741			CP 741		
		Pattern Radius			Pattern Radius		
		103 FT	206 FT	1035 FT	95 FT	190 FT	952 FT
APAM I NON-POP-UP	1	.08	.07	.26	.10	.09	.26
	2	.15	.14	.40	.2	.1	.4
	3	.22	.20	.50	.28	.2	.5
APAM I POP-UP	1	-	-	-	-	-	-
	2						
	3						

BULLDOG CEP	45°/8000 FT	30°/3 FT
10 FT	85	.7
25 FT	.37	.3

1/ Numbers represent the probability that [illegible] truck will be damaged [illegible] selected components of the [illegible] assuming all control and cover- [illegible] effective weapon intervals



TABLE G-6-11. (C) WEAPON EFFECTIVENESS

TARGET: Truck Park; 1000 ft x 1000 ft; 100 trucks — CRITERIA: K-kill [1/]

WEAPON	NO.	45°/5500 FT			30°/3000 FT			20°/2000 FT			10°/500 FT		
		IRON-SIGHT	CP 741	10 Mil	IRON-SIGHT	CP 741	10 Mil	IRON-SIGHT	CP 741	10 Mil	IRON-SIGHT	CP 741	10 Mil
MK 81	2 4 6 8	-	-	-	-	-	-	-	-	-	NA	NA	NA
MK 81SE	2 4 6 8	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	-	-
MK 82	2 4 6 7	.002 .004 .006 .007	-		.002 .005 .007 .008	-	-	.002 .005 .007 .008	-	-	NA	NA	NA
MK 82SE	2 4 6 7	NA	NA	NA	NA	NA	NA	NA	NA	NA	.003 .005 .007 .008	-	-
MK 83	1 2 3 4	.002 .004 .006 .008	-	-	.002 .004 .006 .008	-	-	.002 .004 .006 .008	-	-	NA	NA	NA
MK 77 FIREBOMB	2 4 6 7	NA	NA	NA	NA	NA	NA	NA	NA	NA	.004 .008 .012 .014	-	-
ROCKEYE	1 2 4 6	-	.00 .01 .02 .02	.01 .01 .02 .02	-	-	-	-	.00 .01 .01 .02	.00 .01 .01 .02	-	-	-
ZUNI PODS MK 32	2 4 6	.0005 .001 .002	-	-	.0005 .001 .002	-	-	.0005 .001 .002	-	-	NA	NA	NA
ZUNI PODS MK 63	2 4 6	-	-	-	-	-	-	-	-	-	-	-	-
2.75" PODS M151	2 4 6	.001 .002 .003	-	-	.001 .002 .003	-	-	.001 .002 .003	-	-	NA	NA	NA

WEAPON		45°/5500 FT				20°/2000 FT			
		CP 741		10 Mil		CP 741		10 Mil	
		Pattern Radius		Pattern Radius		Pattern Radius		Pattern Radius	
		103 FT	206 FT	103 FT	206 FT	95 FT	190 FT	95 FT	190 FT
APAM I NON-POP-UP	1 2 3	.01 .02 .02	.01 .02 .02	.01 .02 .02	.01 .02 .02	.01 .02 .02	.01 .02 .03	.01 .02 .02	.01 .02 .03
APAM I POP-UP	1 2 3	-	-	-	-	-	-	-	-

BULLDOG CEP	45°/8000 FT	30°/3000 FT
10 FT	.006	.006
25 FT	.002	.002

NOTE: 1/ P_k numbers represent the percentage of the total number of trucks in the truck park that suffer the K-kill (i.e., truck rendered unusable and not feasible to repair).





TABLE G-6-12 (C) WEAPON EFFECTIVENESS

TARGET: Medium Tank

CRITERION: K-Kill 1/

WEAPON	No.	45°/5500 FT			30°/3000 FT			20°/2000 FT			10°/500 FT		
		IRON-SIGHT	CP 741	10 Mil	IRON-SIGHT	CP 741	10 Mil	IRON-SIGHT	CP 741	10 Mil	IRON-SIGHT	CP 741	10 Mil
MK 81	2	-	.003	.015	-	.005	.018	-	.009	.019	NA	NA	NA
	4		.006	.028		.009	.036		.014	.032			
	6		.009	.039		.014	.050		.023	.042			
	8		.012	.047		.018	.061		.030	.050			
MK 81SE	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	.020	.033
	4											.034	.050
	6											.041	.060
	8											.043	.065
MK 82	2	-	.004	.020	-	.006	.024	-	.015	.022	NA	NA	NA
	4		.007	.035		.011	.046		.026	.042			
	6		.011	.047		.016	.066		.033	.062			
	7		.013	.052		.019	.065		.040	.070			
MK 82SE	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	.02	.046
	4											.03	.061
	6											.04	.069
	7											.04	.070
MK 83	1	-	.004	.015	-	.006	.020	-	.010	.030	NA	NA	NA
	2		.006	.030		.009	.046		.019	.052			
	3		.008	.040		.012	.060		.027	.070			
	4		.009	.050		.014	.070		.034	.083			
MK 77 - FIREBOMB	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	-	-
	4												
	6												
	7												
ROCKEYE 3/	1	-	.02	.08	-	.03	.12	-	.06	.15	-	.14	.32
	2		.04	.14		.06	.21		.11	.25		.25	.52
	4		.07	.23		.09	.33		.19	.38		.35	.71
	6		.09	.28		.13	.37		.26	.43		.40	.82
ZUNI PODS MK 32	2	.003	-	-	.004	-	-	.006	-	.045 2/	NA	NA	NA
	4	.005			.005			.015		.080			
	6	.007			.011			.022		.110			
ZUNI PODS MK 63	2	-	-	-	-	-	-	-	-	-	-	-	-
	4												
	6												
2.75" PODS M151	2	.005	-	-	.007	-	-	.015	-	.082 2/	NA	NA	NA
	4	.010			.014			.030		.150			
	6	.016			.024			.045		.200			

Notes: 1/ P_k numbers represent the probability that the tank will be destroyed or damaged beyond repair.

2/ P_k numbers are for 5-mil forward firing accuracy.

WEAPON	No.	45°/5500 FT				20°/3000 FT			
		CP 741 Pattern Radius		10 Mil Pattern Radius		CP 741 Pattern Radius		10 Mil Pattern Radius	
		100 FT	206 FT	100 FT	206 FT	95 FT	190 FT	95 FT	190 FT
APAM I 3/ NON-POP-UP	1	.01	.01	.04	.01	.02	.01	.03	.01
	2	.03	.02	.06	.02	.04	.02	.05	.03
	3	.04	.02	.09	.03	.05	.02	.08	.03
APAM I 3/ POP-UP	1	-	-	-	-				
	2								
	3								

3/ Recent intelligence data on the T-54 tank has led vulnerability experts to lower the amount of vulnerable area of this tank that is susceptible to damage by penetrating warheads such as in Rockeye II and APAM I. Estimates indicate that the P_k values in this Table for Rockeye II and APAM I should lie between 60% to 80% of the values shown. Comparison of values in this range show that Rockeye II is still the best weapon choice for the T-54 tank on a P_k basis.

BULLDOG CEP	45°/8000 FT	30°/3000 FT
10 FT	.30	.23
25 FT	.06	.03

TABLE G-13. (C) WEAPON EFFECTIVENESS

TARGET: Medium Tank

CRITERION: P_K (P_e, P_{ar}, P_{aT}) 1/

WEAPON	NO.	45°/5500 FT			30°/3000 FT			20°/2000 FT			10°/500 FT		
		IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL
MK 81	2		.006	.034		.007	.045		.020	.040			
	4	-	.011	.060	-	.013	.080	-	.036	.078	NA	NA	NA
	6		.015	.080		.019	.100		.050	.110			
	8		.020	.091		.024	.107		.062	.121			
MK 81SE	2											.033	.053
	4	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	.049	.096
	6											.057	.120
	8											.059	.125
MK 82	2		.008	.034		.011	.050		.025	.040			
	4		.015	.060		.020	.086		.042	.078			
	6	-	.020	.086	-	.027	.113	-	.052	.114	NA	NA	NA
	7		.022	.097		.028	.124		.058	.132			
MK 82SE	2											.040	.072
	4											.061	.113
	6	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	.070	.130
	7											.072	.132
MK 63	1		.005	.026		.008	.042		.020	.042			
	2		.009	.047		.016	.078		.036	.078			
	3	-	.012	.064	-	.023	.110	-	.050	.110	NA	NA	NA
	4		.015	.080		.027	.134		.060	.134			
MK 77 FIREBOMB	2												
	4	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	-	-
	6												
	7												
ROCKEYE 3/	1		.05	.2		.07	.3		.13	.32		.27	.59
	2	-	.09	.37	-	.13	.55	-	.20	.53	-	.40	.81
	4		.16	.58		.23	.87		.35	.77		.49	.93
	6		.21	.68		.29	1.0		.43	.94		.51	.96
ZUNI PODS MK 32	2	.006			[illegible]			[illegible]		[illegible]			
	4	.011	-	-	[illegible]	-	-	[illegible]	-	[illegible]	NA	NA	NA
	6	.017			[illegible]			[illegible]		[illegible]			
ZUNI PODS MK 63	2												
	4	-	-	-	-	-	-	-	-	-	-	-	-
	6												
2.75" PODS M151	2	.014			[illegible]			[illegible]		[illegible]			
	4	.028	-	-	[illegible]	-	-	[illegible]	-	[illegible]	NA	NA	NA
	6	.041			[illegible]			[illegible]		[illegible]			

WEAPON		45°/5500 FT				20°/2000 FT			
		CP 741		10 MIL		CP 741		10 MIL	
		Pattern Radius		Pattern Radius		Pattern Radius		Pattern Radius	
		103 FT	206 FT	103 FT	206 FT	50 FT	100 FT	50 FT	100 FT
APAM I 3/ NON-POP-UP	1	.04	.02	.11	.03	.05	.03	.07	.02
	2	.07	.04	.17	.06	.09	.05	.14	.04
	3	.10	.06	.21	.08	.12	.06	.18	.05
APAM I 3/ POP-UP	1								
	2	-	-	-	-	-	-	-	-
	3								

BULLDOG CEP	45°/8000 FT	30°/3000 FT
10 FT	.45	.33
25 FT	.11	.06

Notes: 1/ P_K numbers represent the probability that any combination of the mobility, firepower, or K-kill as defined on page G-13 will be suffered by the tank.

2/ P_K numbers are for 5-mil forward firing accuracy.

3/ Recent intelligence data on the T-64 tank has led vulnerability experts to lower the amount of vulnerable area of this tank that is susceptible to damage by penetrating warheads such as in Rockeye II and APAM I. Estimates indicate that the P_K values in this table for Rockeye II and APAM I should lie between 60% to 80% of the values shown. Comparison of values in this range show that Rockeye II is still the best weapon choice for the T-64 tank on a P_K basis.

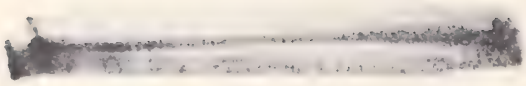




TABLE G-6-14. (C) WEAPON EFFECTIVENESS

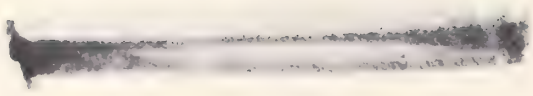
TARGET: Tank Column CRITERION: K-Kill [1/]

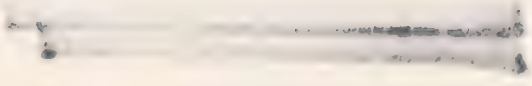
WEAPON	No.	45°/5500 FT			30°/3000 FT			20°/2000 FT			10°/500 FT		
		IRON-SIGHT	CP 741	10 Mil	IRON-SIGHT	CP 741	10 Mil	IRON-SIGHT	CP 741	10 Mil	IRON-SIGHT	CP 741	10 Mil
MK 81	2 4 6 8	-	-	-	-	-	-	-	-	-	NA	NA	NA
MK 81SE	2 4 6 8	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	-	-
MK 82	2 4 6 7	.004 .007 .010 .011	-	-	.005 .010 .014 .017	-	-	.009 .017 .023 .026	-	-	NA	NA	NA
MK 82SE	2 4 6 7	NA	NA	NA	NA	NA	NA	NA	NA	NA	.010 .020 .030 .040	-	-
MK 83	1 2 3 4	.002 .004 .006 .008	-	-	.002 .005 .008 .011	-	-	.004 .008 .012 .017	-	-	NA	NA	NA
MK 77 FIREBOMB	2 4 6 7	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	-	-
ROCKEYE	1 2 4 6	-	.01 .02 .03 .05	.01 .02 .04 .07	-	-	-		.02 .03 .06 .08	.02 .05 .06 .09	-	-	-
ZUNI PODS MK 32	2 4 6	.001 .003 .005	-	-	.003 .005 .007	-		.006 .011 .015	-	-	NA	NA	NA
ZUNI PODS MK 63	2 4 6	-	-	-	-	-	-		-	-	-	-	-
2.75" PODS M151	2 4 6	.004 .008 .011	-	-	.011 .016	-		.021 .031	-	-	NA	NA	NA

WEAPON		45°/5500 FT				20°/2000 FT			
		CP 741		10 Mil		CP 741		10 Mil	
		Pattern Radius		Pattern Radius		Pattern Radius		Pattern Radius	
		100 FT	200 FT	100 FT	200 FT	95 FT	190 FT	95 FT	190 FT
APAM I NON-POP-UP	1 2 3	.01 .02 .02	.00 .01 .01	.01 .03 .04	.01 .02 .03	.01 .02 .03	.01 .02 .02	.01 .03 .04	.01 .02 .02
APAM I POP-UP	1 2 3	-	-	-		-	-		-

BULLDOG STEP	45°/8000 FT	30°/3000 FT
10 FT	.030	.020
25 FT	.008	.008

NOTE: [1/] P_k values represent the percentage of tanks in the column that will suffer the [illegible] destructive damage beyond repair





[redacted]

TABLE C-6-15. (C) WEAPON EFFECTIVENESS

TARGET: Tank Column — CRITERION: M-, F-, K-KILL[1/]

WEAPON	NO.	45°/8500 FT			30°/3000 FT			20°/2000 FT			10°/500 FT		
		IRON-SIGHT	CP 741	10 M11	IRON-SIGHT	CP 741	10 M11	IRON-SIGHT	CP 741	10 M11	IRON-SIGHT	CP 741	10 M11
MK 81	2 4 6 8	-	-	-	-	-	-	-	-	-	NA	NA	NA
MK 81SE	2 4 6 8	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	-	-
MK 82	2 4 6 7	.004 .008 .010 .011	-	-	.007 .012 .015 .016	-	-	.015 .018 .022 .027	-	-	NA	NA	NA
MK 82SE	2 4 6 7	NA	NA	NA	NA	NA	NA	NA	NA	NA	.008 .015 .023 .025	-	-
MK 83	1 2 3 4	.003 .007 .010 .013	-	-	.005 .009 .012 .015	-	-	.013 .019 .025	-	-	NA	NA	NA
MK 77 FIREBOMB	2 4 6 7	-	-	-	-	-	-	-	-	-	-	-	-
ROCKEYE	1 2 4 6	-	.03 .05 .10 .14	.05 .09 .15 .21	-	-	-	-	.04 .07 .14 .20	.05 .10 .17 .24	-	-	-
ZUNI PODS MK 32	2 4 6	.005 .009 .011	-	-	.007 .012 .015	-	-	.013 .024 .035	-	-	NA	NA	NA
ZUNI PODS MK 63	2 4 6	-	-	-	-	-	-	-	-	-	-	-	-
2.75" PODS M151	2 4 6	.010 .020 .030	-	-	.012 .024 .035	-	-	.020 .041 .061	-	-	NA	NA	NA

WEAPON		45°/8500 FT				20°/2000 FT			
		CP 741		10 M11		CP 741		10 M11	
		Pattern Radius		Pattern Radius		Pattern Radius		Pattern Radius	
		103 FT	206 FT	103 FT	206 FT	98 FT	196 FT	98 FT	196 FT
APAM I NON-POP-UP	1 2 3	.02 .04 .06	.02 .03 .05	.03 .06 .08	.02 .04 .05	.02 .04 .06	.02 .03 .05	.03 .05 .08	.02 .03 .05
APAM I POP-UP	1 2 3	-	-	-	-	-	-	-	-

BULLDOG CEP	45°/8000 FT	30°/3000 FT
10 FT	.045	.033
25 FT	.011	.011

NOTE: 1/ P[illegible] represent the percentage of [illegible] that suffer any [illegible] of the mobility, firepower, [illegible]

[redacted]

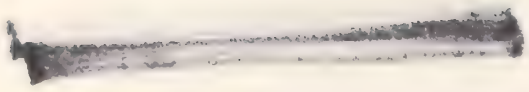




TABLE G-6-16. (C) WEAPON EFFECTIVENESS

TARGET: Armored Personnel Carrier

CRITERION: M- or P-Kill[1/]

WEAPON	#	45°/5500 FT			30°/3000 FT			20°/2000 FT			10°/.00 FT		
		IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL
MK 81	2 4 5 3	-	-	-	-	-	-	-	-	-	-	-	-
MK 81SE	2 4 6 8	-	-	-	-	-	-	-	-	-	-	-	-
MK 82	2 4 6 7	-	-	-	-	-	-	-	-	-	-	-	-
MK 82SE	2 4 6 7	-	-	-	-	-	-	-	-	-	-	-	-
MK 83	1 2 3 4	-	-	-	-	-	-	-	-	-	-	-	-
MK 77 FIREBOMB	2 4 6 7	-	-	-	-	-	-	-	-	-	-	-	-
ROCKEYE	1 2 4 6	-	.07 .12 .21 .29	.15 .26 .43 .54	-	-	-	-	.11 .19 .33 .43	.20 .31 .49 .58	-	-	-
ZUNI PODS MK 32	2 4 6	-	-	-	-	-	-	-	-	-	-	-	-
ZUNI PODS MK 63	2 4 6	-	-	-	-	-	-	-	-	-	-	-	-
2.75" PODS M151	4 4 6	-	-	-	-	-	-	-	-	-	-	-	-

WEAPON	#	45°/5500 FT				20°/2000 FT			
		CP 741		10 MIL		CP 741		10 MIL	
		Pattern Radius		Pattern Radius		Pattern Radius		Pattern Radius	
		103 FT	206 FT	103 FT	206 FT	95 FT	190 FT	95 FT	190 FT
APAM I NON-POP-UP	1 2 3	.07 .13 .18	.06 .11 .15	.22 .32 .40	.08 .14 .19	.10 .20 .29	.06 .12 .18	.15 .32 .43	.06 .13 .19
APAM I POP-UP	1 2 3	-	-	-	-	-	-	-	-

BULLDOG CEP	45°/8000 FT	30°/3000 FT
10 FT	-	-
25 FT	-	-

NOTE: 1/ P_k numbers are the probability of rendering the Armored Personnel Carrier incapable of controlled movement and/or incapacitating the cargo personnel.



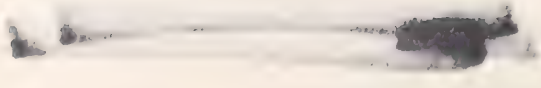


TABLE G-6-17. (C) WEAPON EFFECTIVENESS AGAINST [illegible]

TARGET: Gas Cache

WEAPON	No.	45°/5500 FT			30°/3000 FT			20°/2000 FT	
		IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741
MK 81	2	-	.025	.14	-	.037	.17	-	.08
	4		.049	.24		.066	.30		.14
	6		.068	.31		.089	.39		.19
	8		.085	.37		.109	.45		.22
MK 81SE	2	NA	NA	NA	NA	NA	NA	NA	NA
	4								
	6								
	8								
MK 82	2	-	.030	.16	-	.050	.20	-	.11
	4		.056	.28		.102	.36		.19
	6		.083	.37		.130	.48		.25
	7		.097	.40		.141	.52		.27
MK 82SE	2	NA	NA	NA	NA	NA	NA	NA	NA
	4								
	6								
	7								
MK 83	1	-	.023	.11	-	.027	.13	-	.06
	2		.044	.20		.054	.25		.11
	3		.061	.27		.074	.34		.15
	4		.076	.34		.120	.46		.23
MK 77 FIREBOMB	2	-	-	-	-	-	-	-	-
	4								
	6								
	7								
ROCKEYE	1	-	.11	.38	-	-	-	-	.07
	2		.20	.60					.15
	4		.36	.74					.18
	6		.47	.83					.21
ZUNI PODS MK 32	2	.011	-	-	.014	-	-	.022	-
	4	.021			.027			.044	
	6	.030			.040			.065	
ZUNI PODS MK 63	2	-	-	-	-	-	-	-	
	4								
	6								
2.75" PODS M151	2	.030	-	-	.047	-	-	.075	-
	4	.068			.089			.145	
	6	.097			.124			.200	

WEAPON	No.	45°/5500 FT				20°/2000 FT			
		CP 741		10 MIL		CP 741		10 MIL	
		Pattern Radius		Pattern Radius		Pattern Radius		Pattern Radius	
		103 FT	206 FT	103 FT	206 FT	95 FT	190 FT	95 FT	190 FT
APAM I NON-POP-UP	1	.19	.33	.41	.39	.31	.47	.52	.46
	2	.32	.50	.64	.59	.48	.68	.79	.68
	3	.42	.62	.83	.74	.60	.78	.91	.82
APAM I POP-UP	1	-	-	-	-	-	-	-	-
	2								
	3								

BULLDOG CEP	45°/9000 FT	30°/3000 FT
10 FT	.62	.73
25 FT	.41	.29

NOTES: 1/ P_k numbers [illegible] destroying [illegible] 50% of [illegible]

2/ P_k numbers [illegible] 40% of [illegible]

TABLE G-6-18. (C) WEAPON EFFECTIVENESS

TARGET: Ammo Dump CRITERION: Destroy 1/

WEAPON	NO.	45°/5500 FT IRON-SIGHT	45°/5500 FT CP 741	45°/5500 FT 10 MIL	30°/3000 FT IRON-SIGHT	30°/3000 FT CP 741	30°/3000 FT 10 MIL	20°/2000 FT IRON-SIGHT	20°/2000 FT CP 741	20°/2000 FT 10 MIL	10°/500 FT IRON-SIGHT	10°/500 FT CP 741	10°/500 FT 10 MIL
MK 81	2	-	.004	.016	-	.006	.028	-	.015	.030	NA	NA	NA
	4		.009	.032		.011	.054		.030	.058			
	6		.012	.050		.017	.077		.042	.085			
	8		.015	.068		.023	.088		.054	.108			
MK 81SE	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	.028	.04
	4											.041	.07
	6											.047	.08
	8											.049	.08
MK 82	2	-	.005	.036	-	.011	.043	-	.028	.046	NA	NA	NA
	4		.011	.065		.021	.085		.051	.090			
	6		.016	.087		.031	.121		.069	.128			
	7		.019	.097		.033	.138		.077	.146			
MK 82SE	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	.034	.08
	4											.056	.12
	6											.070	.15
	7											.074	.15
MK 83	1	-	.004	.034	-	.010	.035	-	.020	.069	NA	NA	NA
	2		.009	.062		.020	.071		.038	.110			
	3		.013	.085		.028	.102		.054	.137			
	4		.017	.104		.037	.132		.071	.160			
MK 77 FIREBOMB	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	.22	.26
	4											.38	.45
	6											.50	.58
	7											.55	.63
ROCKEYE	1	-	.08	.35	-	.12	.58	-	.25	.57	-	.37	.82
	2		.15	.55		.20	.78		.39	.80		.48	.92
	4		.23	.74		.30	.95		.54	.93		.54	.98
	6		.30	.80		.37	.97		.68	.95		.55	.98
ZUNI PODS MK 32	2	.003	-	-	.006	-	-	.004	-	.022 2/	NA	NA	NA
	4	.006			.011			.017		.09			
	6	.012			.016			.26		.13			
ZUNI PODS MK 63	2	-	-	-	-	-	-	-	-	-	-	-	-
	4												
	6												
2.75" PODS M151	2	.019	-	-	.025	-	-	.042	-	.2 2/	NA	NA	NA
	4	.037			.049			.072		.31			
	6	.054			.071			.115		.46			

WEAPON		45°/5500 FT CP 741 Pattern Radius		45°/5500 FT 10 MIL Pattern Radius		20°/2000 FT CP 741 Pattern Radius		20°/2000 FT 10 MIL Pattern Radius	
		103 FT	205 FT	103 FT	206 FT	95 FT	190 FT	95 FT	190 FT
APAM I NON-POP-UP	1	.17	.29	.47	.33	.29	.46	.50	.42
	2	.29	.45	.68	.53	.45	.65	.77	.61
	3	.39	.56	.80	.66	.58	.72	.88	.73
APAM I POP-UP	1	-	-	-	-	-	-	-	-
	2								
	3								

BULLDOG CEP	45°/8000 FT	30°/3000 FT
10 FT	.36	.28
25 FT	.06	.05

NOTES: 1. P_k numbers represent the probability of complete destruction of the ammunition dump.

2. P_k numbers are for 5-mil forward firing accuracy.

TABLE G-6-19. (C) WEAPON EFFECTIVENESS

TARGET: Diesel Fuel Cache

CRITERION: Destroy [1/]

WEAPON	No.	45°/5500 FT			30°/3000 FT			20°/2000 FT			10°/500 FT		
		IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL
MK 81	2	-	.010	.05	-	.015	.08	-	.040	.09	NA	NA	NA
	4		.020	.10		.028	.15		.075	.16			
	6		.029	.15		.040	.205		.106	.22			
	8		.038	.19		.051	.245		.134	.27			
MK 81SE	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	.055	.135
	4											.10	.20
	6											.12	.23
	8											.122	.24
MK 82	2	-	.015	.07	-	.038	.13	-	.060	.21	NA	NA	NA
	4		.026	.13		.055	.21		.110	.285			
	6		.040	.19		.071	.26		.150	.28			
	7		.047	.22		.077	.28		.160	.32			
MK 82SE	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	.085	.20
	4											.144	.29
	6											.17	.32
	7											.175	.322
Mk 83	1	-	.015	.05		.032	.12		.040	.09	NA	NA	NA
	2		.025	.10		.050	.205	-	.075	.16			
	3		.033	.14		.071	.27		.110	.22			
	4		.039	.18		.082	.33		.143	.27			
MK 77 FIREBOMB	2	-	-	-	-	-	-	-	-	-	-	-	-
	4												
	6												
	7												
ROCKEYE	1	-	.10	.22					.26	.44	-	-	-
	2		.19	.39					.46	.73			
	4		.33	.65					.82	.86			
	6		.44	.79					.86				
ZUNI PODS MK 32	2	.005	-	-	.007				-	.015 [2/]	NA	NA	NA
	4	.010			.014					.32			
	6	.016			.021					.34			
ZUNI PODS MK 63	2	-	-	-	-	-	-	-	-	-	-	-	-
	4												
	6												
2.75" PODS M151	2	.022	-	-	.026	-	-	-	-	.14	NA	NA	NA
	4	.043			.050								
	6	.063			.069								

WEAPON		45°/8500 FT				30°/8000 FT			
		CP 741		10 MIL		CP 741		10 MIL	
		Pattern Radius		Pattern Radius		Pattern Radius		Pattern Radius	
		103 FT	206 FT	103 FT	206 FT	55 FT	90 FT	55 FT	90 FT
APAM I NON-POP-UP	1	.17	.30	.44	.65	.26	.47	.43	.73
	2	.30	.48	.71	.95	.41	.67	.62	.96
	3	.40	.59	.83	.70	.56	.76	.74	
APAM I POP-UP	1	-	-	-	-	-	-	-	-
	2								
	3								

BULLDOG CEP	45°/8000 FT	30°/3000 FT
10 FT	.67	.82
25 FT	.21	.15

NOTES: 1/ [illegible] represent the probability of destroying, or setting fire to, at least [illegible] of the gasoline drums.

2/ [illegible] are for all forward firing [illegible].





TABLE G-6-20. (C) WEAPON EFFECTIVENESS

TARGET: Bunker

CRITERION: Collapse [1]

WEAPON	NO.	45°/5500 FT			30°/3000 FT			20°/2000 FT			10°/500 FT		
		IRON-SIGHT	CP 741	10-M11	IRON-SIGHT	CP 741	10 M11	IRON-SIGHT	CP 741	10 M11	IRON-SIGHT	CP 741	10 M11
MK 81	2	-	.009	.050	-	.011	.03	-	.040	.11	NA	NA	NA
	4		.019	.095		.023	.15		.072	.175			
	6		.028	.138		.035	.195		.098	.22			
	8		.034	.180		.047	.23		.118	.26			
MK 81SE	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	.066	.130
	4											.094	.170
	6											.112	.185
	8											.112	.185
MK 82	2	-	.010	.055	-	.022	.09	-	.[illegible]	.11	NA	NA	NA
	4		.021	.105		.041	.16		.[illegible]	.175			
	6		.032	.150		.056	.215		.[illegible]	.23			
	7		.038	.172		.063	.24		.[illegible]	.26			
MK 82SE	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	.068	.150
	4											.102	.185
	6											.120	.200
	7											.122	.200
Mk 83	1	-	.010	.050	-	.018	.08	-	.042	.09	NA	NA	NA
	2		.020	.100		.035	.13		.076	.16			
	3		.029	.142		.[illegible]	.[illegible]		.102	.21			
	4		.035	.180		.[illegible]	.24		.123	.265			
MK 77 FIREBOMB [2]	2	-	-	-	-	-	-	-	-	-	-	-	-
	4												
	6												
	7												
ROCKEYE [2]	1	-	-	-	-	-	-	-	-	-	-	-	-
	2												
	4												
	6												
ZUNI PODS MK 32 [2]	2	-	-	-	-	-	-	-	-	-	-	-	-
	4												
	6												
ZUNI PODS MK 63 [2]	2	-	-	-	-	-	-	-	-	-	-	-	-
	4												
	6												
2.75" PODS M151 [2]	2	-	-	-	-	-	-	-	-	-	-	-	-
	4												
	6												

WEAPON	NO.	45°/5500 FT			30°/3000 FT			20°/2000 FT			10°/500 FT		
		IRON-SIGHT	CP 741	10-M11	IRON-SIGHT	CP 741	10 M11	IRON-SIGHT	CP 741	10 M11	IRON-SIGHT	CP 741	10 M11
[illegible]													
[illegible] [2]	1	-	-	-	-	-	-	-	-	-	-	-	-
[illegible]	2												
	3												
[illegible] [2]	1	-	-	-	-	-	-	-	-	-	-	-	-
[illegible] POP-UP	2												
	3												

BULLDOG CEP	45°/6000 FT	30°/3000 FT
10 FT	.68	.50
25 FT	.70	.33

NOTES: 1. Numbers represent the probability of [illegible] the wall or ceiling, causing a [illegible] of structural integrity [illegible] fill by dirt and debris, thereby rendering the bunker unusable.

2. [illegible] suitable to achieve [illegible]

TABLE G-6-21. [illegible]

TARGET: Pillbox

CRITERION: Collapse

WEAPON	NO.	45°/5000 FT			30°/3000 FT			20°/2000 FT			10°/500 FT		
		IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL
MK 81	2	-	.010	.04	-	.009	.08	-	.033	.06	NA	NA	NA
	4		.017	.09		.017	.13		.055	.12			
	6		.022	.11		.025	.16		.071	.16			
	8		.026	.13		.035	.18		.088	.20			
MK 81SE	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	.050	.13
	4											.071	.17
	6											.080	.18
	8											.081	.18
MK 82	2	-	.012	.05	-	.020	.08	-	.056	.07	NA	NA	NA
	4		.020	.09		.035	.14		.084	.13			
	6		.027	.12		.047	.18		.103	.18			
	7		.033	.15		.051	.20		.112	.21			
MK 82SE	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	.061	.13
	4											.080	.17
	6											.090	.18
	7											.094	.18
Mk 83	1	-	.016	.04	-	.009	.07	-	.034	.04	NA	NA	NA
	2		.022	.06		.020	.12		.066	.10			
	3		.029	.13		.047	.17		.095	.15			
	4		.033	.16		.058	.21		.122	.21			
MK 77 2/ FIREBOMB	2	-	-	-	-	-	-	-	-	-	-	-	-
	4												
	6												
	7												
ROCKEYE 2/	1	-			-			-			-	-	-
	2												
	4												
	6												
ZUNI 2/ PODS MK 32	2	-	-	-	-	-	-	-	-	-	-	-	-
	4												
	6												
ZUNI 2/ PODS MK 63	2	-	-	-							-	-	-
	4												
	6												
2.75" 2/ PODS M151	2	-	-	-	-	-	-	-	-	-	-	-	-
	4												
	6												

WEAPON	NO.	[illegible] FT			[illegible] FT			[illegible] FT			[illegible] FT		
		[illegible]	CP 741	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] 2/	1	-	-	-	-	-	-	-	-	-	-	-	-
	2												
	3												
[illegible] 2/	1												
	2												
	3												

BULLDOG CEP	45°/8000 FT	30°/5000 FT
10 FT	.57	.42
25 FT	.14	.09

NOTES: 1/ [illegible] numbers represent the probability of [illegible] the [illegible] sections to cause [illegible] breakage of [illegible] integrity and pressure [illegible] with scabbing or [illegible] effects rendering the pillbox unusable

2/ [illegible]

TABLE G-6-22. (C) WEAPON EFFECTIVENESS

TARGET: Hardened Cave

CRITERION: Collapse 1/

WEAPON	NO.	45°/5500 FT			30°/3000 FT			20°/2000 FT			10°/500 FT		
		IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL
MK 81	2 4 6 8	-	.015 .026 .037 .045	.05 .095 .140 .180	-	.016 .032 .047 .060	.100 .175 .230 .270	-	.04 .08 .11 .14	.09 .18 .25 .31	NA	NA	NA
MK 81SE	2 4 6 8	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	.082 .106 .115 .116	.14 .20 .23 .24
MK 82	2 4 6 7	-	.017 .034 .050 .058	.090 .160 .220 .245	-	.032 .052 .066 .070	.130 .220 .290 .315	-	.08 .13 .16 .17	12 .22 .31 .35	NA	NA	NA
MK 82SE	2 4 6 7	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	.093 .120 .130 .132	.18 .24 .26 .26
Mk 83	1 2 3 4	-	.016 .031 .045 .057	.100 .165 .230 .265	-	.036 .060 .077 .090	.10 .21 .30 .38	-	.10 .15 .18 21	18 .29 .36 .42	NA	NA	NA
MK 77 - 2/ FIREBOMB	2 4 6 7	-	-	-	-	-	-	-	-	-	-	-	-
ROCKEYE 2/	1 2 4 6	-	-	-	-	-	-	-	-	-	-	-	-
ZUNI 2/ PODS MK 32	2 4 6	-	-	-	-	-	-	-	-	-	-	-	-
ZUNI 2/ PODS MK 63	2 4 6	-	-	-	-	-	-	-	-	-	-	-	-
2.75" 2/ PODS M151	2 4 6	-	-	-	-	-	-	-	-	-	-	-	-

WEAPON		30°/3000 FT				20°/2000 FT			
		CP 741 Pattern Radius		10 MIL Pattern Radius		CP 741 Pattern Radius		10 MIL Pattern Radius	
		100 FT	200 FT	100 FT	200 FT	75 FT	125 FT	75 FT	100 FT
CBU 1 2/ POP-POP-UP	1 2 3	-	-	-	-	-	-	-	-
CBU 1 2/ POP-UP	1 2 3	-	-	-	-	-	-	-	-

BULLDOG CEP	45°/8000 FT	30°/3000 FT
10 FT	.67	.69
25 FT	.27	.20

NOTES: 1/ P_k numbers represent the probability of breaching the concrete lining of the cave, rupturing the steel door, or entering the cavity and detonating inside.

2/ Weapon not considered suitable to [illegible] criterion.





TABLE G-6-23 (C) [illegible] 1/

TARGET: Temporary Wooden Bridge CRITERION: Drop

WEAPON	No.	45°/5500 FT			22°/2000 FT			20°/2000 FT			10°/500 FT		
		IRON-SIGHT	CP 741	10 Mil	IRON-SIGHT	CP 741	10 Mil	IRON-SIGHT	CP 741	10 Mil	IRON-SIGHT	CP 741	10 Mil
MK 81	2	-	.08	.25	-	.11	.34	-	.23	.32	NA	NA	NA
	4		.15	.43		.20	.51		.39	.50			
	6		.20	.58		.28	.62		.49	.60			
	8		.245	.68		.35	.69		.57	.67			
MK 81SE	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	.34	.39
	4											.46	.47
	6											.50	.51
	8											.50	.52
MK 82	2	-	.10	.28	-	.165	.40	-	.28	.32	NA	NA	NA
	4		.18	.47		.28	.57		.44	.50			
	6		.24	.62		.36	.67		.54	.62			
	7		.26	.67		.38	.70		.58	.67			
MK 82SE	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	.39	.41
	4											.51	.54
	6											.56	.57
	7											.56	.59
MK 83	1	-	.065	.27	-	.09	.38	-	.23	.26	NA	NA	NA
	2		.12	.43		.16	.45		.36	.43			
	3		.16	.56		.23	.57		.45	.54			
	4		.23	.64		.31	.67		.52	.62			
MK 77 FIREBOMB 2/	2	-	-	-	-	-	-	-	-	-	-	-	-
	4												
	6												
	7												
ROCKEYE 2/	1	-	-	-	-	-	-	-	-	-	-	-	-
	2												
	4												
	6												
ZUNI PODS MK 32 2/	2	-	-	-	-	-	-	-	-	-	-	-	-
	4												
	6												
ZUNI PODS MK 63 2/	2	-			-	-					-	-	-
	4												
	6												
2.75" PODS M151 2/	2	-	-	-	-	-	-	-	-	-	-	-	-
	4												
	6												
[illegible] 2/	2	-	-	-	-	-	-						
	4												
[illegible] 2/	4	-											
	6												

BULLDOG	45°/6000 FT	30°/5000 FT
10 FT	.26	.62
25 FT	.39	.91

[illegible] 1/ [illegible] the probability dropping the single [illegible] of the [illegible]

2/ [illegible] not considered suitable for

TABLE G-6-24. (C) WEAPON EFFECTIVENESS 1/

TARGET: Steel Truss Bridge CRITERION: Drop

WEAPON	NO.	45°/8000 FT IRON-SIGHT	45°/8000 FT CP 741	45°/8000 FT 10 M11	30°/3000 FT IRON-SIGHT	30°/3000 FT CP 741	30°/3000 FT 10 M11	20°/2000 FT IRON-SIGHT	20°/2000 FT CP 741	20°/2000 FT 10 M11	10°/500 FT IRON-SIGHT	10°/500 FT CP 741	10°/500 FT 10 M11
MK 81	2	-	.003	.008	-	.004	.010	-	.006	.008	NA	NA	NA
	4		.006	.016		.007	.020		.012	.017			
	6		.008	.024		.011	.029		.019	.025			
	8		.010	.032		.015	.038		.025	.033			
MK 81SE	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	.010	.010
	4											.015	.016
	6											.017	.018
	8											.018	.019
MK 82	2	-	.004	.014	-	.005	.016	-	.010	.014	NA	NA	NA
	4		.008	.026		.011	.031		.021	.028			
	6		.012	.038		.017	.043		.031	.039			
	7		.014	.043		.019	.049		.036	.045			
MK 82SE	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	.017	.019
	4											.023	.025
	6											.026	.028
	7											.027	.028
MK 83	1	-	.003	.014	-	.005	.015	-	.010	.018	NA	NA	NA
	2		.007	.029		.011	.039		.021	.031			
	3		.010	.041		.016	.047		.031	.041			
	4		.013	.051		.021	.056		.040	.050			
MK 77 FIREBOMB 2/	2	-	-	-	-	-	-	-	-	-	-	-	-
	4												
	6												
	7												
ROCKEYE 2/	1	-	-	-	-	-	-	-	-	-	-	-	-
	2												
	4												
	6												
ZUNI PODS MK 32 2/	2	-	-	-	-	-	-	-	-	-	-	-	-
	4												
	6												
ZUNI PODS MK 63 2/	2	-	-	-	-	-	-	-	-	-	-	-	-
	4												
	6												
2.75" PODS M151 2/	2	-	-	-	-	-	-	-	-	-	-	-	-
	4												
	6												

WEAPON	NO.	45°/8000 FT CP 741	45°/8000 FT 10 M11	30°/3000 FT CP 741	30°/3000 FT 10 M11	20°/2000 FT CP 741	20°/2000 FT 10 M11	10°/500 FT CP 741	10°/500 FT 10 M11
[illegible] 2/	1	-	-	-	-	-	-	-	-
	3								
[illegible] 2/	1	-	-	-	-	-	-	-	-
	3								

BULLDOG CEP	45°/8000 FT	30°/3000 FT
10 FT	.026	.020
25 FT	.011	.008

NOTE: 1/ [illegible] numbers represent the probability of collapsing a span of the bridge.

2/ [illegible] considered suitable for [illegible] bridge span

CONFIDENTIAL

TABLE G-6-25 (C) WEAPON EFFECTIVENESS

TARGET: Building 98 x 35 ft, 2 Story Wood Frame CRITERION: Collapse

WEAPON	NO.	45°/5500 FT			30°/3000 FT			20°/2000 FT			10°/500 FT		
		IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL
MK 81	2 4 6 8	-	.03 .05 .07 .09	-	-	.04 .08 .10 .13	.19 .31 .40 .47	-	.09 .16 .21 .25	.18 .31 .40 .47	NA	NA	NA
MK 81SE	2 4 6 8	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	-	-
MK 82	2 4 6 7	-	.05 .09 .13 .14	.23 .37 .47 .51	-	.08 .14 .18 .20	.30 .47 .58 .63	-	.17 .27 .34 .37	.30 .47 .58 .62	NA	NA	NA
MK 82SE	2 4 6 7	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	-	-
Mk 83	1 2 3 4	-	- .10 - -	- .38 - -	-	- .15 - -	- .46 - -	-	- .29 - -	- .45 - -	NA	NA	NA
MK 77 FIREBOMB	2 4 6 7	-	-	-	-	-	-	-	-	-	-	-	-
ROCKEYE	1 2 4 6	-	-	-	-	-	-	-	-	-	-	-	-
2.75" FFARS MK 32	2 4 6	-	-	-	-	-	-	-	-	-	-	-	-
5"/54 FFARS MK 63	2 4 6	-	-	-	-	-	-	-	-	-	-	-	-
2.75" FFARS MK51	2 4 6	-	-	-	-	-	-	-	-	-	-	-	-

WEAPON		45°/8000 FT				30°/3000 FT			
		CP 741 Pattern Radius		10 MIL Pattern Radius		CP 741 Pattern Radius		10 MIL Pattern Radius	
		103 FT	206 FT	113 FT	226 FT	95 FT	333 FT	25 FT	100 FT
APAM I NON-POP-UP	1 2 3	-	-	-	-	-	-	-	-
APAM I POP-UP	1 2 3	-	-	-	-	-	-	-	-

MUNITIONS CEP	45°/8000 FT	30°/3000 FT
10 FT	-	-
25 FT	-	-

CONFIDENTIAL

CONFIDENTIAL

TABLE G-6-26. (C) WEAPON EFFECTIVENESS

TARGET: Flak Site

CRITERION: Expected # of Guns Suppressed 1/

WEAPON	No.	45°/5500 FT			30°/3000 FT			20°/2000 FT			10°/500 FT		
		IRON-SIGHT	CP 741	10 M11	IRON-SIGHT	CP 741	10 M11	IRON-SIGHT	CP 741	10 M11	IRON-SIGHT	CP 741	10 M11
MK 81	2 4 6 8	-	-	-	-	-	-	-	-	-	-	-	-
MK 81SE	2 4 6 6	-	-	-	-	-	-	-	-	-	-	-	-
MK 82	2 4 6 7	-	-	-	-	-	-	-	-	-	-	-	-
MK 82SE	2 4 6 7	-	-	-	-	-	-	-	-	-	-	-	-
MK 83	1 2 3 4	-	-	-	-	-	-	-	-	-	-	-	-
MK 77 FIREBOMB	2 4 6 7	-	-	-	-	-	-	-	-	-	-	-	-
ROCKEYE	1 2 4 6	.8 1.2 1.8 2.1	-	-	1.1 1.8 2.2 2.3	-	-	-	-	-	-	-	-
ZUNI PODS MK 32	2 4 6	-	-	-	-	-	-	-	-	-	-	-	-
ZUNI PODS MK 63	2 4 6	-	-	-	-	-	-	-	-	-	-	-	-
2.75" PODS M151	2 4 6	-	-	-	1.7 2.3 2.8	-	-	-	-	-	-	-	-

WEAPON	No.	45°/5500 FT				20°/2000 FT			
		CP 741		10 M11		CP 741		10 M11	
		Pattern Radius		Pattern Radius		Pattern Radius		Pattern Radius	
		103 FT	206 FT	103 FT	206 FT	95 FT	190 FT	95 FT	190 FT
APAM I NON-POP-UP	1 2 3	-	-	-	-	-	-	-	-
APAM I POP-UP	1 2 3	-	-	-	-	-	-	-	-

BULLDOG CEP	45°/3000 FT	30°/3000 FT
10 FT	-	-
25 FT	-	-

NOTE: 1/ P_k numbers represent the expected number of guns suppressed (out of 8 guns), where a gun is considered suppressed if 5 of the 8 crew members are incapacitated.

CONFIDENTIAL

TABLE G-6-27. (C) WEAPON EFFECTIVENESS

TARGET: Kobar

CRITERION: Sink [1/]

WEAPON	NO.	45°/5500 FT			30°/3000 FT			20°/2000 FT			10°/500 FT		
		IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL
MK 81	2	-	.04	.15	-	.049	.23	-	.10	.22	NA	NA	NA
	4		.073	.27		.087	.39		.18	.39			
	6		.099	.38		.114	.49		.24	.50			
	8		.118	.46		.135	.56		.29	.57			
MK 81SE	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	.19	.32
	4											.29	.50
	6											.33	.57
	8											.34	.58
MK 82	2	-	.044	.20	-	.061	.30	-	.13	.30	NA	NA	NA
	4		.080	.35		.115	.48		.23	.48			
	6		.108	.46		.160	.58		.31	.58			
	7		.118	.50		.180	.62		.34	.62			
MK 82SE	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	.23	.45
	4											.35	.62
	6											.40	.69
	7											.41	.70
MK 83	1	-	.03	.15	-	.05	.22	-	.12	.27	NA	NA	NA
	2		.062	.27		.13	.42		.21	.43			
	3		.086	.37		.16	.57		.27	.57			
	4		.111	.46		.184	.67		.31	.66			
MK 77 FIREBOMB	2	-	-	-	-	-	-	-	-		-	-	-
	4												
	6												
	7												
ROCKEYE	1	-	.01	.04	-	.02	.05	-	.04	.09	-	.09	.28
	2		.02	.06		.04	.10		.08	.17		.18	.54
	4		.04	.14		.06	.20		.14	.25		.31	.75
	6		.05	.17		.06	.23		.17	.28		.38	.79
ZUNI PODS MK 32	2	.002	-	-	.003	-	-	.004	-	.020	NA	NA	NA
	4	.004			.006			.008		.042			
	6	.005			.007			.011		.062			
ZUNI PODS MK 63	2	-	-	-	-	-	-	-	-	-	-	-	-
	4												
	6												
2.75" PODS M151	2	.002	-	-	.003	-	-	.004	-	.024	NA	NA	NA
	4	.004			.006			.009		.045			
	6	.006			.008			.014		.072			

WEAPON		45°/5500 FT				20°/2000 FT			
		CP 741		10 MIL		CP 741		10 MIL	
		Pattern Radius		Pattern Radius		Pattern Radius		Pattern Radius	
		100 FT	200 FT	100 FT	200 FT	95 FT	190 FT	95 FT	190 FT
APAM I NON-POP-UP	1	-	-	-	-	-	-	-	-
	2								
	3								
APAM I POP-UP	1	-	-	-	-	-	-	-	-
	2								
	3								

BULLDOG CEP	45°/8000 FT	30°/3000 FT
10 FT	.82	.82
25 FT	.51	.40

NOTE: 1/ P_k numbers represent the probability of sinking a stationary KORAR.

2/ P_k numbers are for S-mil forward firing accuracy.



TABLE G-6-28. (C) WEAPON EFFECTIVENESS

TARGET: [illegible] CRITERION: Sink

WEAPON	NO.	45°/5500 FT			30°/5000 FT			20°/2000 FT			10°/500 FT		
		IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL	IRON-SIGHT	CP 741	10 MIL
MK 81	2	-	.02	.15	-	.04	.20	-	.10	.20	NA	NA	NA
	4		.05	.25		.07	.34		.18	.35			
	6		.07	.35		.10	.45		.23	.46			
	8		.08	.42		.13	.53		.26	.53			
MK 81SE	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	.13	.29
	4											.24	.44
	6											.29	.52
	8											.30	.53
MK 82	2	-	.04	.17	-	.06	.32	-	.11	.23	NA	NA	NA
	4		.06	.28		.09	.43		.20	.35			
	6		.09	.34		.12	.50		.26	.40			
	7		.10	.41		.15	.54		.29	.44			
MK 82SE	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	.19	.40
	4											.29	.56
	6											.33	.60
	7											.33	.61
MK 83	1	-	.03	.12	-	.04	.19	-	.07	.16	NA	NA	NA
	2		.07	.25		.07	.29		.14	.26			
	3		.08	.31		.10	.34		.17	.30			
	4		.09	.36		.12	.41		.20	.32			
MK 77 FIREBOMB 1/	2	-	-	-	-	-	-	-	-	-	-	-	-
	4												
	6												
	7												
ROCKEYE 1/	1	-	-	-	-	-	-	-	-	-	-	-	-
	2												
	4												
	6												
ZUNI 1/ PODS MK 32	2	-	-	-	-	-	-	-	-	-	-	-	-
	4												
	6												
ZUNI 1/ PODS MK 63	2	-	-	-	-	-	-	-	-	-	-	-	-
	4												
	6												
2.75" 1/ PODS M151	2	-	-	-	-	-	-	-	-	-	-	-	-
	4												
	6												

WEAPON	NO.	45°/5500 FT				30°/5000 FT			
		CP 741 Pattern Radius		10 MIL Pattern Radius		CP 741 Pattern Radius		10 MIL Pattern Radius	
		105 FT	60 FT	105 FT	60 FT	95 FT	55 FT	120 FT	70 FT
[illegible] 1/ [illegible]-POP-UP	1	-	-	-	-	-	-	-	-
	2								
	3								
[illegible] 1/ [illegible]-POP UP	1	-	-	-	-	-	-	-	-
	2								
	3								

BULLDOG CEP	45°/8000 FT	30°/5000 FT
10 FT	.02	.03
25 FT	.46	.36

NOTE: 1/ Weapon not considered suitable for [illegible] criterion.

[redacted]

SECTION 7. WEAPON SELECTION (U)

701. (U) General. The selection of the best weapons for the AV-8A will be treated in four parts in this section. The first part will discuss the selection of current operational free-fall and unguided forward-firing weapons. The second part will discuss the possible changes in preferred weapons due to the introduction of new weapons in the 1971-1980 time frame. The third part will discuss guided missiles, both currently operational missiles and those in the R&D stage. The fourth part contains an analysis of the percentage of ordnance in the weapon mix for a deployed AV-8A squadron.

702. (C) Ordnance Loads. As previously stated, for purposes of comparing weapons, only "pure loads" or loads consisting of a single type weapon plus the Aden 30mm guns are considered. It is certainly conceivable that there may be cases where mixed loads are desirable; however, this report does not identify these cases. Tables G-7-1 and G-7-2 show the weapon loads considered. Weapons are compared on the basis of the loads shown in the two tables; this is not meant to imply that the weapons will be delivered in the stick lengths used for comparison purposes. Tactics for delivering various loads of weapons will be determined in the AV-8A tactical manuals. The tables show the loads that were compared for a given take-off run (vertical of 600 feet) both with and without guns. Since vertical take-off is envisioned for Forward Sites, the mission chosen was a 50-nautical mile radius. The short take-off mission chosen was a 200-nautical mile radius. The other important ground rules in this comparison were: one weapon on each outboard wing station, one or two on each inboard, and one on the centerline; weight limitations are 600 pounds on the outboard stations and 1,100 pounds on each inboard or centerline station. The maximum station limitation considered for this study is seven stations. If dual weapon racks are put on the outboard stations, as many as nine weapons could be carried with reduced maneuverability limits.

703. (C) Current Free-Fall and Unguided Firing Weapons. Weapon selection for this category of weapons is based primarily on the P_k tables in Section 6 of this annex and the weapon loads given above. No consideration is given to the cost of weapons in this study. The selection will be made within the framework of the three missions: Close Air Support (CAS), Deep Air Support (DAS), and Armed Reconnaissance (ARREC) as described in Section 2 of this annex.

a. Weapon Selection for the CAS Mission.

(1) It was assumed earlier that about 85 percent of the AV-8A's combat sorties will be conducted in support

[redacted]

TABLE G-7-1. (C) COMPARATIVE WEAPON LOADS FOR AV-8A VERTICAL TAKE-OFF

Mission Profile	Weapon	Number/Weight of Weapons	
		With Guns (2,100-Pound Limit)	Without Guns (3,000-Pound Limit)
Vertical take-off, 50 miles to target, 50-mile return	Mk 81, Conical Fins	7/1820*	7/1820*
	MK 81, Snakeye Fins	7/2100*	7/2100*
	Mk 82, Conical Fins	3/1590	5/2650
	Mk 82, Snakeye Fins	3/1695	5/2825
	Mk 83, Conical Fins	2/1970	2/1970**
	Rockeye II	4/1960	6/2940
	Mk 77 Firebomb	4/2080	5/2600
	LAU-10 Zuni Pod	2/1066***	4/2132***
	LAU-69 2.75-Inch Rocket Pod	4/2028	4/2028***

* Station limitation, seven stores is the maximum stores possible with dual carriage racks on only the inboard stations.

** Mk 83 cannot be carried on centerline, symmetric loading requires only two weapons.

*** Rockets cannot be carried on centerline, symmetric loading requires only even number of pods.

TABLE G-7-2. (C) COMPARATIVE WEAPON LOADS FOR AV-8A 600-FOOT TAKE-OFF

Mission Profile	Weapon	Number/Weight of Weapons	
		With Guns (3,330-Pound Limit)	Without Guns (4,230-Pound Limit)
600-foot take-off 100-nautical mile mission radius	Mk 81, Conical Fins	7/1820*	7/1820*
	Mk 81, Snakeye Fins	7/2100*	7/2100
	Mk 82, Conical Fins	7/3710*	7/3710
	Mk 82, Snakeye Fins	6/3390	7/3955
	Mk 83, Conical Fins	2/1920**	2/1970**
	Rockeye II	7/3430*	3/3430*
	Mk 77 Firebomb	7/3640*	7/3640*
	LAU-10 Zuni Pod	6/3198***	6/3198***
	LAU-69 2.75-Inch Pocket Pod	6/3042***	6/3042***

* Station limitation, seven stores is the maximum stores possible with dual carriage racks on only the inboard wing stations.

** Station limitation, Mk 83 can only be carried on the inboard wing stations.

*** Station limitation, rockets cannot be carried on centerline.





of the CAS mission. The following five targets were estimated to comprise about 90 percent of the encounters on this mission:

(a) Troops in foxholes.

(b) Small-weapon positions (mortar, machine-gun, etc.).

(c) Trucks.

(d) Troops in the open.

(e) Armored vehicles.

(2) For this group of targets, the P_k tables show, except for (b), that Rockeye II is the best weapon for both take-off runs (vertical and 600 feet) and for all delivery conditions. The reason for exception of target (b), the small-weapon position, is because Rockeye II P_k's were not available for this target, so there was no basis for comparison. In general, Rockeye II appeared from two to 10 times more effective than the next best weapon.

(3) Second and third choice weapons for this group of high frequency CAS targets varied between Mk 81 and Mk 82 bombs. In a few cases, Zuni/Mk 63 and 2.75-inch rockets were second or third choice weapons. Tables G-7-3 through G-7-6 show the comparison between the three best weapons for a typical situation for the tank, truck, and troop targets. These tables show the 30-degree dive, 3,000-foot release for the tank and truck and the 10-degree dive, 500-foot release for the troops. The only difference for other release conditions is in the relative magnitude of the P_k's; in order of weapon, choice does not vary. For the 10-degree dive, 500-foot release, the choice of Mk 81 or Mk 82 refers to the Snakeye configured bombs. The tables also include accuracy values (10-mil and CP-741, and iron sight for troops) and the take-off conditions.

(4) The tables have another value. For example, the tank numbers (Table 6-6-13) show that the P_k for two Rockeyes are higher than for sticks of seven Mk 81 or Mk 82 bombs. Thus if a 600-foot take-off run were available and seven Rockeyes were carried, a higher P_k could be obtained by dropping just two Rockeyes (leaving five more Rockeyes for additional passes or for other targets) than could be obtained by dropping a whole load of seven Mk 81's or Mk 82's in a single pass at the target. The same is true for the truck but not for troops. However, in the case of troops,



TABLE G-7-3. (C) COMPARISON OF FIRST, SECOND, AND THIRD BEST WEAPONS

TARGET: Tank (See Table G-6-13)
CRITERION: M-, F-, or K-Kill
DELIVERY: 30 Degrees/3,000 Feet

MISSION PROFILES:
1. VTO, 50-Nautical Mile Radius.
2. 600-Foot STO, 100-Nautical Mile Radius.

With Guns

	Order of Choice	10-Mil Accuracy		CP-741 Accuracy	
		Take-Off Distance, Feet		Take-Off Distance, Feet	
		0 (VTO)	600 (STO)	0 (VTO)	600 (STO)
Number and Kind of Weapon P_k	1st*	4 RE/.675	7 RE/.72	4 RE/.20	7 RE/.30
	2d**	7 Mk 81/.104	7 Mk 82/.124	2 LAU-69/.124	6 LAU-69/.058
	3d**	3 Mk 82/.068	7 Mk 81/.104	4 Mk 81/.013	7 Mk 82/.028

Without Guns

Number and kind of Weapon P_k	1st*	6 RE/.72	7 RE/.72	6 RE/.27	7 RE/.30
	2d	7 Mk 81/.104	7 Mk 82/.124	4 LAU-69/.04	6 LAU-69/.058
	3d	2 Mk 83/.071	7 Mk 81/.104	7 Mk 81/.022	6 LAU-10 7 Mk 82/.028

* RE=Rockeye II. Recent intelligence data on the T-54 tank has led vulnerability experts to lower the amount of vulnerable area of this tank that is susceptible to damage by penetrating warheads such as in Rockeye II. Estimates indicate that the P_k values in this table for Rockeye II should lie between 60% and 80% of the values shown. Comparison of values in this range show that Rockeye II is still the best weapon choice for the T-54 tank on a P_k basis.

** P_k data were not available for LAU-69 or LAU-10 with 5-mil accuracy. It is possible that these weapons would be competitive with the bombs, as is the case for the CP-741 accuracy.

TABLE G-7-4. (C) COMPARISON OF FIRST, SECOND, AND THIRD BEST WEAPONS

TARGET: Truck (See Table G-6-9)
CRITERION: M-, F-, or K-Kill
DELIVERY: 30 Degrees/3,000 Feet

MISSION PROFILES:
1. VTO, 50-Nautical Mile Radius.
2. 600-Foot STO, 100-Nautical Mile Radius.

	Order of Choice	10-Mil Accuracy		CP-741 Accuracy	
		Take-Off Distance, Feet		Take-Off Distance, Feet	
		0 (VTO)	600 (STO)	0 (VTO)	600 (STO)
With Guns					
Number and kind of Weapon Pk	1st	4 RE*/.40	7 RE/.45	4 RE/.12	7 RE/.18
	2d	7 Mk 82/.245	7 Mk 82/.245	7 Mk 81/.040	7 Mk 82/.056
	3d	3 Mk 82/.125	7 Mk 81/.199	3 Mk 82/.029	7 Mk 81/.040
Without Guns					
Number and kind of Weapon Pk	1st	6 RE/.45	7 RE/.45	6 RE/.12	7 RE/.18
	2d	7 Mk 81/.199	7 Mk 82/.245	2 Mk 83/.039	7 Mk 82/.058
	3d	2 Mk 83/.135	7 Mk 81/.199	2 Mk 83/.038	7 Mk 81/.040

* RE = Rockeye II.

TABLE G-7-5 (C) COMPARISON OF FIRST, SECOND, AND THIRD BEST WEAPONS

TARGET: Troops in the Open, Prone
150 x 300-Foot Area
CRITERION: 5-Minute Assault (See Table G-6-2)
DELIVERY: 10 Degrees/500 Feet

MISSION PROFILES:
1. VTO, 50-Nautical Mile Radius.
2. 600-Foot STO, 100-Nautical Mile Radius.

With Guns

	Order of Choice	10-Mil Accuracy*		CP-471 Accuracy**	
		Take-Off Distance, Feet		Take-Off Distance, Feet	
		0 (VTO)	600 (STO)	0 (VTO)	600 (STO)
Number and Kind of Weapon Pk	1st			4 RE/.60	7 RE/.65
	2d			2 Zuni/ VCMR/.38	6 Mk 82SE***/.57****
	3d			7 Mk 81SE/.51	7 Mk 81SE/.51

Without Guns

Number and Kind of Weapon Pk	1st			6 RE/.65	7 RE/.65
	2d			7 Mk 81SE/.51	7 Mk 82SE/.64****
	3d			5 Mk 82 SE/.49	7 Mk 81SE/.51

* Pk's not available for 10-Mil system for troop targets.
** RE = Rockeye II; Rockeye Pk's are for CP-741 accuracy.
*** SE = Snakeye.
**** Pk numbers not available for six pods Zuni/VMCR.





TABLE G-7-6. (C) COMPARISON OF FIRST, SECOND, AND THIRD BEST WEAPONS

TARGET: Troops in the Open, Prone 150 x 300-Foot Area
CRITERION: 5-Minute Assault (See Table G-6-2)
DELIVERY: 10 Degrees/500 Feet

MISSION PROFILES:
1. VTO, 50-Nautical Mile Radius.
2. 600-Foot STO, 100-Nautical Mile Radius.

With Guns

	Order of Choice	10-Mil Accuracy* Take-Off Distance, Feet		Iron Sight Accuracy** Take-Off Distance, Feet	
		0 (VTO)	600 (STO)	0 (VTO)	600 (STO)
Number and Kind of Weapon P_k	1st			4 RE/.25	7 RE/.27
	2d			2 Zuni/ VCMR/.12	6 Mk 82SE***/.156****
	3d			3 Mk 82SE/.113	7 Mk 81SE/.099

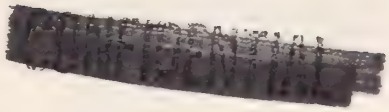
Without Guns

Number and Kind of Weapon P_k	1st			6 RE/.27	7 RE/.27
	2d			4 Zuni/ VCMR/.21	7 Mk 82SE/.165****
	3d			5 Mk 82SE/.145	7 Mk 81SE/.099

* P_k's not available for 10-Mil system for troop targets.
** RE = Rockeye II; Rockeye P_k's are for CEP-741 accuracy.
*** SE = Snakeye.
**** P_k data not available for six pods Zuni/VMCR.







the tables (G-7-5 and G-7-6) show that there is little increase in P_k beyond four Rockeyes (i.e., almost the same P_k is obtained for four to seven weapons).

(5) Limited information available on the Zuni rocket with the new Mk 63 VCMR warhead indicates that it may be superior to Rockeye for the troop targets. The only P_k data available for this weapon in this study are for troops in the 150 x 300-foot area and for the small-weapon position. These preliminary numbers would indicate that Zuni with the Mk 63 might actually be the most effective weapon (at least in these cases). Table G-7-7 shows the P_k values for the troop targets (numbers are not available for six LAU-10A/A pods).

TABLE G-7-7. (C) ZUNI VCMR P_k'S AGAINST TROOPS IN A 150 X 300-FOOT AREA FOR 30-DEGREE DIVE, 3,000-FOOT RELEASE

	Troops in the Open, Prone		Troops in Foxholes, Crouching	
	Iron Sight	5-Mil	Iron Sight	5-Mil
2 Pods	.38	.63	.12	.23
4 Pods	.52	.84	.21	.39

(6) The remaining 10 percent of targets for the CAS missions are:

(a) Bunkers.

(b) Supply caches.

(c) Bridges.

(d) AAA Sites.

(e) Road and trail junctions, chokepoints.

(7) For the bunker, the Mk 81 and the Mk 82 are about equally effective. Table G-7-8 shows that for the vertical take-off, the Mk 81 is superior; whereas for the 600-foot take-off loads, the best weapon is the Mk 82.







TABLE G-7-8. (C) COMPARISON OF FIRST, SECOND, AND THIRD BEST WEAPONS

TARGET: Bunker (See Table G-6-20)
CRITERION: Collapse
DELIVERY: 30 Degrees/3,000 Feet

MISSION PROFILES:
1. VTO, 50-Nautical Mile Radius.
2. 600-Foot STO, 100-Nautical Mile Radius.

	Order of Choice	10-Mil Accuracy		CEP-741 Accuracy	
		Take-Off Distance, Feet		Take-Off Distance, Feet	
		0 (VTO)	600 (STO)	0 (VTO)	600 (STO)
		With Guns			
Number and Kind of Weapon P_K	1st	7 Mk 81/.21	7 Mk 82/.24	7 Mk 81/.041	7 Mk 82/.063
	2d	2 Mk 83/.13	7 Mk 81/.21	2 Mk 83/.035	7 Mk 81/.041
	3d	3 Mk 82/.125	2 Mk 83/.13	3 Mk 82/.032	2 Mk 83/.035
		Without Guns			
Number and Kind of Weapon P_K	1st	7 Mk 81/.21	7 Mk 82/.24	5 Mk 82/.049	7 Mk 82/.063
	2d	5 Mk 82/.188	7 Mk 83/.21	7 Mk 81/.041	7 Mk 81/.041
	3d	2 Mk 83/.13	2 Mk 83/.13	2 Mk 83/.035	2 Mk 83/.035





[redacted]

(8) For wooden bridges, the best weapons are Mk 81's and Mk 82's, and here the breakpoint is about five Mk 82's. That is, if the AV-8A can carry five or more Mk 82's, then they are better than Mk 81's; for less than five Mk 82's six or seven Mk 81's are better. The same is true for the steel truss bridge. Table G-6-9 shows the weapon comparison for the steel bridge is similar, but the P_k's are much smaller.

(9) For the supply cache, the most effective weapon is Rockeye. Bombs and rockets appear to be at least an order of magnitude less effective than a weight-equivalent load of Rockeyes. Table G-6-10 shows the comparison for the ammunition cache. This is the hardest of the three caches, but the weapon choice for the three caches is the same.

(10) For the AAA flak site, P_k data were not available for the same weapons as for the above targets. The P_k's for the flak site were calculated in TAAS for proximity fuzing (VT) with Mk 82 and Mk 83 bombs. The AV-8A has no capability for the electric proximity fuzes. P_k's were available for Rockeye and, in one case, for 2.75-inch FFAR. The criterion for kill in this case is killing or incapacitating five out of an eight-man crew and the "P_k" numbers are actually the expected number of guns suppressed in a six-gun 57mm site. The most effective weapon for the AV-8A is Rockeye for this target. The P_k numbers for the flak site were not available in TAAS for the Zuni with the Mk 63 VCMR warhead. However, another study (reference 9) contains some comparative data for Rockeye II and Zuni/Mk 63. The P_k numbers indicate Rockeye is superior, but on a cost-effectiveness basis, the Zuni is more cost-effective than Rockeye.

(11) The target called Road and Trail Junctions and Chokepoints is treated only in a qualitative sense. It is not clear what is desired to be achieved at a junction--cratering or destroying some equipment or personnel at the junction. Clearly, if it is equipment or personnel, then the best weapon would be the Rockeye II for that target (it is not really the junction that is the target). If it is cratering (which has generally proved to be ineffective because craters are easily filled in or bypassed), then clearly bombs are the best weapons--either Mk 81's or Mk 82's. The Mk 82's would make the largest craters. No P_k tables are given for this target because of the difficulty of defining an adequate "kill criterion."

(12) Aden Guns.

(a) An important weapon for which comparative P_k data is not available is the Aden 30mm gun. The approach

[redacted]



TABLE G-7-9. (C) COMPARISON OF FIRST, SECOND, AND THIRD BEST WEAPONS

TARGET: Wooden Bridge (See Table G-6-23)
CRITERION: Collapse
DELIVERY: 30 Degrees/3,000 Feet

MISSION PROFILES:
1. VTO, 50-Nautical Mile Radius.
2. 600-Foot STO, 100-Nautical Mile Radius.

With Guns

	Order of Choice	10-Mil Accuracy		CEP-741 Accuracy	
		Take-Off Distance, Feet		Take-Off Distance, Feet	
		0 (VTO)	600 (STO)	0 (VTO)	600 (STO)
Number and Kind of Weapon P_k	1st	7 Mk 81/.66	7 Mk 82/.70	7 Mk 81/.32	7 Mk 82/.38
	2d	3 Mk 82/.49	7 Mk 81/.66	3 Mk 82/.22	7 Mk 81/.32
	3d	2 Mk 83/.45	2 Mk 83/.45	2 Mk 83/.18	2 Mk 83/.18
Without Guns					
Number and Kind of Weapon P_k	1st	7 Mk 81/.66	6 Mk 72/.70	7 Mk 81/.32	7 Mk 82/.38
	2d	5 Mk 82/.62	7 Mk 81/.66	5 Mk 82/.32	5 Mk 81/.32
	3d	2 Mk 83/.45	2 Mk 83/.45	2 Mk 83/.18	2 Mk 83/.18





TABLE G-7-10. (C) COMPARISON OF FIRST, SECOND, AND THIRD BEST WEAPONS

TARGET: Ammunition Cache (See Table G-6-18)
CRITERION: Destroy
DELIVERY: 30 Degrees/3,000 Feet

MISSION PROFILES:
1. VTO, 50-Nautical Mile Radius.
2. 600-Foot STO, 100-Nautical Mile Radius.

	Order of Choice	10-Mil Accuracy		CP-741 Accuracy	
		Take-Off Distance, Feet		Take-Off Distance, Feet	
		0 (VTO)	600 (STO)	0 (VTO)	600 (STO)
With Guns					
Number and Kind of Weapon P_k	1st	4 RE*/.88	7 RE/.92	4 RE/.30	7 RE/.34
	2d**	7 Mk 81/.083	7 Mk 82/.138	4 LAU-69/.049	6 LAU-69/.071
	3d**	2 Mk 83/.071	7 Mk 81/.083	7 Mk 81/.020	7 Mk 82/.033
Without Guns					
Number and Kind of Weapon P_k	1st	6 RE/.92	7 RE/.92	6 RE/.39	7 RE/.34
	2d	5 Mk 82/.103	7 Mk 81/.138	4 LAU-69/.049	6 LAU-69/.071
	3d	7 Mk 81/.083	7 Mk 81/.083	5 Mk 82/.026	7 Mk 82/.033

* RE = Rockeye II.

** P_k data not available for LAU-69 for 5-mil forward firing accuracy. It is possible the rockets may be competitive with the bombs as is the case for CP-741 accuracy.



[redacted]

taken in this report was to compare the effectiveness of the AV-8A for other weapon loads with and without guns; i.e., if the gun pods are taken off and 900 pounds of other ordnance is put on, what is the increase in effectiveness? For the CAS mission, the most frequently encountered targets were best defeated by Rockeye. The comparative Rockeye loads with and without guns for the vertical and 600-foot take-offs are:

	Vertical	600-Foot
With Guns	4 RE	7 RE
Without Guns	6 RE	7 RE

For the 600-foot take-off, the same Rockeye effectiveness is available with or without guns. In the vertical take-off, there is an increase in Rockeye effectiveness if the guns are taken off. The question becomes: Which is more effective, two additional Rockeyes or two Aden 30mm gun pods? Examination of the P_k tables for the targets in question (tank, truck, troops) shows the gain between four and six Rockeyes is not significant and the effectiveness of guns plus four Rockeyes is probably at least that of seven Rockeyes and no guns. A plus factor for the guns is the forward-firing capability.

(b) For the other CAS targets where bombs are most effective (bunkers and bridges), the increase in effectiveness that would be gained by leaving off guns and adding more bombs is marginal in most cases. There is no increase in effectiveness by leaving off guns if a 600-foot take-off is available, because a full load of bombs can be carried with or without guns. For the vertical take-off, there is some increase in effectiveness by adding more bombs, but it is felt that the number of times that an AV-8A will have to respond to a bridge or bunker target with a fast reaction vertical take-off or a very short take-off would be small. To have AV-8A's configured without guns for an anticipated reaction against bridges and bunkers would handicap the aircraft on other more frequently occuring missions where guns would be effective.

(c) In conclusion, it is felt that there is strong evidence that the AV-8A's should always carry guns on the CAS missions, and that in only a few infrequently occurring situations will this result in any significant loss in effectiveness.

[redacted]





[redacted]

b. Weapon Selection for the Deep Air Support (DAS) Mission.

(1) The DAS mission is assumed to account for approximately 10 percent of the AV-8A's combat sorties. These missions are preplanned, and the large majority will be originated from a Main Base or Facility. It will probably be rare to conduct this mission with vertical take-offs. Consequently, the 600-foot take-off condition should have the most importance in selection of weapons for this mission.

(2) It is estimated that the following three targets will account for about 77 percent of the DAS mission encounters:

(a) Field supply caches.

(b) Buildings.

(c) Bridges.

(3) The weapon selection for the field supply caches does not differ from the selection for the CAS mission. That is, Rockeyes are the preferred weapon (see Table G-7-10). It should be pointed out that P_k numbers for the Zuni with the WCMR warhead were not available; it is quite likely that for the field supply caches, this Zuni will be competitive with Rockeye.

(4) For the building, P_k's were available for only the Mk 81, Mk 82, and Mk 83 bombs as they are the only current weapons under consideration that have the capability to collapse the structure. Table G-7-11 shows the effectiveness of the bombs for the two take-off conditions. With a 600-foot take-off, the Mk 82 load is the most effective. Mk 83's are superior for the vertical take-off with guns, while the Mk 82 shows up as superior for the vertical take-off without guns.

(5) The selection for bridges was discussed in the CAS mission. Briefly, the Mk 82 is superior if fewer than five Mk 82's can be carried. If five or more Mk 82's can be carried, they are better than Mk 81's.

(6) Approximately 12 percent of the DAS mission sorties will be against the following three targets:

(a) Trail and road junctions, chokepoints.

(b) AAA sites.

[redacted]

TABLE G-7-11. (C) COMPARISON OF FIRST, SECOND, AND THIRD BEST WEAPONS

TARGET: Building (See Table G-6-25)
CRITERION: Collapse
DELIVERY: 30 Degrees/3,000 Feet

MISSION PROFILES:
1. VTO, 50-Nautical Mile Radius.
2. 600-Foot STO, 100-Nautical Mile Radius.

	Order of Choice	10-Mil Accuracy		CP-741 Accuracy	
		Take-Off Distance, Feet		Take-Off Distance, Feet	
		0 (VTO)	600 (STO)	0 (VTO)	600 (STO)
With Guns					
Number and Kind of Weapon P_K	1st	2 Mk 83/.46	7 Mk 82/.63	2 Mk 83/.15	7 Mk 82/.20
	2d	7 Mk 81/.44	2 Mk 83/.46	7 Mk 81/.12	2 Mk 83/.15
	3d	3 Mk 82/.39	7 Mk 81/.44	3 Mk 82/.11	7 Mk 81/.12
Without Guns					
Number and Kind of Weapon P_K	1st	5 Mk 82/.53	7 Mk 82/.63	5 Mk 82/.16	7 Mk 82/.20
	2d	2 Mk 83/.46	2 Mk 83/.46	2 Mk 83/.15	2 Mk 83/.15
	3d	7 Mk 81/.44	7 Mk 81/.44	7 Mk 81/.12	7 Mk 81/.12

[redacted]

(c) Truck parks.

(7) The first two of these targets were discussed in the CAS mission. The weapons selected were Rockeye (with Zuni VCMR as a potential competitor) for the AAA site and Mk 82 bombs for the cratering of trail and road junctions. Truck parks are hard to defeat with a single sortie. Maximum AV-8A loads of Rockeye do not even approach a P_k of 0.1 (see Table G-7-12). The P_k for the truck park represents the percentage of trucks in the park that suffer the K-kill criterion. The Rockeye P_k's are on the order of 0.01, but these are two to 10 times the P_k's for bombs and rockets. The preferred weapon is Rockeye with Mk 82 and Mk 83 bombs next. P_k's are not available, but Zuni with the VCMR warhead might do at least as well as the bombs and perhaps as well as Rockeye.

(8) The remaining 11 percent of the DAS mission targets that the AV-8A is expected to conduct attacks against are:

(a) Armored vehicle parks.

(b) Fixed weapon sites (caves, pillboxes, bunkers).

(c) Runways.

(d) Docks.

(9) In this report the closest approximation of an armored vehicle park is a column of 10 T-54 Soviet tanks. Table G-7-13 shows the weapon comparison for this target in the 30-degree dive, 3,000-foot release tactic. Rockeye is the preferred weapon for the tank column. LAU-69 2.75-inch FFAR is the second choice; Zuni with the Mk 82 for third choice. Zuni with the VCMR warhead is an unknown because no P_k's are available.

(10) For the fixed weapon positions (bunkers, pillboxes, and hardened caves), the only weapons considered were Mk 81, Mk 82, and Mk 83. Comparative numbers for the bunker were given in Table G-7-8. For this target, Mk 81 was the best for vertical take-offs and Mk 82 for the 600-foot take-off. The selection of pillboxes is exactly the same, only the P_k's are smaller. Similarly, the choice is the same for the hardened cave. In the case of the cave, the P_k's are between those of the bunker and the pillbox.

(11) A study was conducted in TAAS to determine the vulnerability of airfields to air attack. TAAS points out

[redacted]

TABLE G-7-12. (C) COMPARISON OF FIRST, SECOND, AND THIRD BEST WEAPONS

TARGET: Truck Park (See Table G-6-11)
CRITERION: K-Kill
DELIVERY: 30 Degrees/3,000 Feet

MISSION PROFILES:
1. VTO, 50-Nautical Mile Radius.
2. 600-Foot STO, 100 Nautical Mile Radius.

With Guns

	Order of Choice	10-Mil Accuracy		Iron Sight Accuracy*	
		Take-Off Distance, Feet		Take-Off Distance, Feet	
		0 (VTO)	600 (STO)	0 (VTO)	600 (STO)
Number and Kind of Weapon P_K	1st	4 RE/.02	7 RE/.02	4 RE/.02	7 RE/.02
	2d			3 Mk 82 2 Mk 83/.004	7 Mk 82/.008
	3d			4 LAU-69/.002	2 Mk 83/.004

Without Guns

Number and Kind of Weapon P_K	1st	6 RE/.02	7 RE/.02	6 RE/.02	7 RE/.02
	2d			5 Mk 82/.006	7 Mk 82/.008
	3d			2 Mk 83/.004	2 Mk 83/.004

* RE P_K's are for CP-741 accuracy.

TABLE G-7-13. (C) COMPARISON OF FIRST, SECOND, AND THIRD BEST WEAPONS

TARGET: Tank Column (See Table G-6-15)
CRITERION: M-, F-, or K-Kill
DELIVERY: 30 Degrees/3,000 Feet

MISSION PROFILES:
1. VTO, 50-Nautical Mile Radius.
2. 600-Foot STO, 100-Nautical Mile Radius.

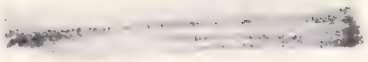
With Guns

	Order of Choice	10-Mil Accuracy		Iron Sight Accuracy*	
		Take-Off Distance, Feet		Take-Off Distance, Feet	
		0 (VTO)	600 (STO)	0 (VTO)	600 (STO)
Number and Kind of Weapon P_k	1st	4 RE/.16	7 RE/.22	4 RE/.12	7 RE/.18
	2d			4 LAU-69/.021	6 LAU-69/.035
	3d			3 Mk 82/.010	6 LAU-10 7 Mk 82/.016

Without Guns

Number and Kind of Weapon P_k	1st	6 RE/.22	7 RE/.22	6 RE/.17	7 RE/.18
	2d			4 LAU-69/.024	6 LAU-69/.035
	3d			5 Mk 82/.014	6 LAU-10 7 Mk 82/.016

* RE accuracy is CEP-741; rocket and bomb accuracy is iron sight accuracy.



[redacted]

that with current weapons, very large numbers of sorties are required to attain even a minimal level of airfield neutralization. This would tend to indicate that naturalizing airfields by bombing runways is not a particularly good mission for the AV-8A. If such missions were flown, the Mk 82 would probably be the most effective weapon for this role.

(12) Very little vulnerability information is available for the defeat of port facilities and, in particular, docks. A typical dock would probably be a harder structure to collapse than the temporary wooden bridge used in this report and certainly not as hard as the steel truss bridge. In any case, because of the large number of pilings, it would be hard to collapse the structure. Numbers are not available, but it is conjectured that Mk 82 bombs would be the most effective weapon for the AV-8A to use in this role.

(13) Aden Guns. In the DAS mission, it is likely that most times a short take-off run will be available. Under these circumstances, the effectiveness to be gained by leaving off the gun pods would be minimal. It is felt that, as in the CAS mission, the AV-8A should always fly with its Aden guns. Even if the guns were not fired on a DAS mission, they would be ready for a quick turnaround on an emergency CAS mission.

c. Weapon Selection for the Armed Reconnaissance Mission.

(1) The third and final mission considered in this report is armed reconnaissance. These missions are estimated to account for about 5 percent of the AV-8A combat sorties. The primary targets in this mission are:

(a) Trucks and towed artillery.

(b) Tanks and armored columns.

(c) Watercraft (PT boats, cruise missile boats, etc.).

(d) Road and trail junctions, chokpoints.

(2) These four targets are expected to account for approximately 85 percent of the armed reconnaissance encounters. For the first two groups of targets, Rockeye was selected as best in the missions discussed above, and that choice holds here.

(3) Watercraft considered in this report are the KOMAR, the Waterborne Logistics Craft (WBLC), and the LDG-16

[redacted]



[redacted]

Guided Missile Frigate. Table G-7-14 shows the P_k's for the KOMAR. Caution should be taken in interpreting the P_k's shown for the KOMAR. It was pointed out in TAAS that these P_k's are for a nonmoving KOMAR, a highly unrealistic situation. The solution taken in TAAS was to degrade the P_k's in order to compensate for movement. The degrading factors differed between weapons, but for bombs they were the same. This report only considers the bombs and Rockeye against KOMAR, and Rockeye is relatively ineffective for a sink kill. The only thing that would be accomplished by applying the degrading factors would be to reduce the P_k's, but this will not change the order of weapon selection. The best weapon for KOMAR is Mk 81 for the vertical take-off with guns and the Mk 82 for the vertical take-off without guns and the 600-foot take-off. Weapon choices for the WBLC were the same. For the DLG-16, the only numbers available were for the Mk 82 and Mk 83 bombs with steel nose plugs and tail fuzes. These bombs are not compatible with the AV-8A because the fuzing is electric. It can be concluded that the AV-8A would have little capability of obtaining the unseaworthy kill on a ship such as the DLG-16, since TAAS indicates the steel nose plugs are necessary to obtain the required penetration depth.

(3) For road and trail junctions, the choice is the same as for the CAS and DAS missions--Mk 82 and Mk 81 bombs.

(4) The remaining 15 percent of the armed reconnaissance targets are:

(a) Bridges.

(b) Troops in the open, prone.

(c) Small-weapon positions (mortar, rocket, etc.).

All three of these targets have been discussed previously. The selected weapons were Mk 82 and Mk 81 for the bridges and Rockeye for the troops and weapon positions with Zuni (VMCR) a strong competitor with Rockeye.

(5) Aden Guns. The argument for Aden guns is stronger for this mission than for the DAS mission because the armed reconnaissance mission is a "target of opportunity" mission. Guns are extremely useful in this type of mission, and since sorties are more apt to originate from a Main Base or Facility, short take-off runs will probably be available, so little effectiveness is gained by leaving guns off.

[redacted]

TABLE G-7-14. (C) COMPARISON OF FIRST, SECOND, AND THIRD BEST WEAPONS

TARGET: KOMAR (See Table G-6-27)
CRITERION: Sink
DELIVERY: 30 Degrees/3,000 Feet

MISSION PROFILES:
1. VTO, 50-Nautical Mile Radius.
2. 600-Foot STO, 100-Nautical Mile Radius.

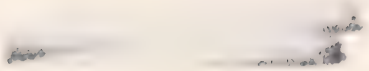
With Guns

	Order of Choice	10-Mil Accuracy		CP-741 Accuracy	
		Take-Off Distance, Feet		Take-Off Distance, Feet	
		0 (VTO)	600 (STO)	0 (VTO)	600 (STO)
Number and Kind of Weapon Pk	1st	7 Mk 81/.53	7 Mk 82/.62	7 Mk 81/.124	7 Mk 82/.180
	2d	2 Mk 83/.42	7 Mk 81/.53	2 Mk 83/.110	7 Mk 81/.124
	3d	3 Mk 82/.39	2 Mk 83/.42	3 Mk 82/.088	2 Mk 83/.110

Without Guns

Number and Kind of Weapon Pk	1st	7 Mk 81/.53	7 Mk 82/.62	5 Mk 82/.138	7 Mk 82/.180
	2d	5 Mk 82/.53	7 Mk 81/.53	7 Mk 81/.124	7 Mk 81/.124
	3d	2 Mk 83/.42	2 Mk 83/.42	2 Mk 83/.110	2 Mk 83/.110





[redacted]

d. Summary of Selection of Free-Fall and Unguided Forward-Firing Weapons.

(1) The targets for the AV-8A fall roughly into two categories--those for which Rockeye is best and those for which Mk 81 and Mk 82 bombs are best. The breakdown is shown below:

Targets Where Rockeye Is Most Effective	Targets Where Mk 81 or Mk 82 Bombs Are Most Effective
Troops in the Open	Bunkers, Caves, Pillboxes
Troops in Foxholes	Bridges
Small-Weapon Positions	Road and Trail Junctions, Choke-points
Trucks, Truck Parks	Buildings
Tanks, Tank Columns	Runways
Field Supply Caches	Docks
AAA Sites	Watercraft

(2) There appears to be a potential weapon competitive with Rockeye for many of the Rockeye targets; that weapon is the Zuni with the VCMR warhead. Generally speaking, Rockeye, Mk 81, and Mk 82 showed up as the three best weapons in the majority of situations (except Mk 83 for buildings in VTO). In a few cases, LAU-69 2.75-inch FFAR pods, Zuni pods, and Mk 83 bombs appeared as a second or third choice weapon. In the few cases where Zuni VCMR data were available, it looked impressive.

(3) There is no valid argument for determining a preference between the Mk 81 or the Mk 82 bombs. In some cases, the Mk 81 was better for vertical take-off and the Mk 82 was better for the 600-foot take-off run. The differences in P_k's, however, were insignificant in most cases. Actually, if a direct hit is obtained by either an Mk 81 or an Mk 82 on a target such as a bunker, pillbox, or a bridge, there is a high probaility that it will be destroyed. The small differences in P_k's are actually due to "edge effects." That is, Mk 82 has a slightly large radius of effects, allowing for an Mk 82 bomb to miss the target by a few more feet than an Mk 81 and still damage or destroy it. The important point to note is the tremendous difference in capability with bombs between a 10-mil system and the CP-741 system. If combat accuracy of the AV-8A proves to be no better than CP-741 accuracy, bombs will have limited effectiveness when used from the aircraft. On the other hand, if 10-mil accuracy is obtained, Mk 81 and Mk 82 bombs will definitely be useful. If poor combat bombing accuracy is achieved, the possibility of incorporating guided missiles such as Bulldog and Maverick

[redacted]

[redacted]

on the AV-8A looks very appealing as an alternative to bombs (see paragraph 705). This is a possible area for more detailed study.

(4) On a purely P_K basis, the Mk 77 firebomb does not show up as a preferred weapon for any target. This is a popular weapon for CAS. The desirability of the Mk 77 firebomb is based on its "psychological effect" and on its usefulness in very close proximity to friendly forces. The radius of lethal effects from flying fragments is much less than that for high explosive iron bombs. TAAS indicates that firebombs will not be used from Navy ships, so that if it is decided to use the AV-8A to deliver firebombs, it will be when the aircraft is operating ashore. A similar argument holds for CBU-55B (low speed FAE), but no P_K's are available.

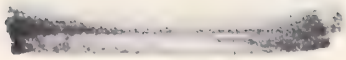
(5) On the basis of the calculations in this report, it is concluded that Mk 83 bombs will have limited usefulness for the AV-8A. This conclusion is largely based on the limitations of weight on the aircraft racks. If the assumptions allowed for only 4.0 g-maneuvers, as many as six Mk 83's could be carried, and in that case, Mk 83's might well be competitive with Mk 81 and Mk 82. The ease of handling the Mk 81 and Mk 82 in loading operations is another argument against the 1,000-pound Mk 83 which is harder to handle and load.

(6) It appears that the AV-8A should always take the Aden 30mm gun on its combat missions. The capability gained by leaving the gun pods off and adding ordnance is marignal and normally occurs only during the vertical take-off. It is felt that the versatility and usefulness of these guns compensate for any loss in capability due to fewer bombs or Rockeyes. The forward firing capability of the guns makes them useful for targets of opportunity and, in search and rescue operations, for providing covering fire for downed aviators. In the 600-foot take-off, the AV-8A can carry the same load with or without guns (under the seven store limitations).

704. (C) Selection of R&D Weapons

a. General. The R&D weapons considered in this report are: Advanced General Purpose Bombs (AGPB), Anti-Personnel Anti-Material Bomblet (APAM), Advanced Incendiary Weapon, Bulldog, Laser-Guided Bombs, Harpoon, and Maverick. With the exception of Bulldog, Harpoon, and Maverick, these will be discussed in the paragraphs below. The missiles are discussed in paragraph 705.

[redacted]





[redacted]

b. Advanced General Purpose Bombs. The AGPB is scheduled to replace the current Mk 80 series bombs within the 1971-1980 time frame. When this series of bombs becomes operational, the Mk 81 and Mk 82 will be phased out. Since it appears that the smallest of the AGPB family will be in the 500-pound class, this means that the 250-pound bomb is going to disappear from the Marine inventory when they are all used up. Consequently, wherever the Mk 81 or Mk 82 is the preferred weapon for the AV-8A, the 500-pound AGPB will be the replacement weapon. P_k's are not available as yet for the AGPB family, so there is no basis for comparison with the Mk 81 or Mk 82. Handling, loading, and arming problems will be reduced when the AGPB becomes operational.

c. Anti-Personnel Anti-Material Bomblet. This weapon is similar to Rockeye; however, it weighs 750 pounds. It is possible that APAM will eventually replace Rockeye; if this happens, it will have important implications for the AV-8A, namely not as many can be carried. If the final APAM design includes the popup mode (when the weapon hits "soft" surfaces, it pops up 3 to 10 feet and detonates in the air), it will significantly increase the effectiveness against troops both in foxholes and in the open. APAM is not as effective against tanks as Rockeye, but the difference in capability is small in most cases. It is quite likely that APAM will become an often-carried weapon for the AV-8A. The P_k tables in Section 6 of this annex contain P_k values for APAM against many of the targets. Except for Bulldog, APAM is the only R&D weapon for which P_k's are available.

d. Advanced Incendiary Weapon. Of all the R&D weapons considered here, probably the Advanced Incendiary Weapon is the one about which the least is known. The anticipated targets for this weapon would certainly include buildings, field caches, and trucks. This weapon will probably not replace any other weapons in the complement of weapons for the AV-8A, but would be in addition to the basic complement.

e. Laser Guided Bombs. The Laser Guided Bomb (LGB) is a conventional bomb with a laser seeker, a guidance unit, and special tail fins delivered as a kit which converts an iron bomb into a semi-active laser homing weapon. A conversion kit has been developed for the 500-pound Mk 82, which is compatible with the AV-8A.

705. (C) Selection of Guided Missiles for the AV-8A. The air-to-ground guided missiles considered as possible weapons for the AV-8A are Bulldog, Maverick, Shrike, and Harpoon. The Sidewinder air-to-air missile is already programmed for AV-8A carriage.

[redacted]





[redacted]

a. Sidewinder. This is the only missile for which the AV-8A is currently configured. The conclusion that can be reached is that if the AV-8A is to be used in the air-to-air role (see Section 9), then Sidewinder is the most effective weapon currently available for the aircraft.

b. Bulldog. The Bulldog missile is considered to be a prime candidate for the AV-8A. It is being developed specifically for the Marines, and it is weight-compatible with the AV-8A. The P_k data available shows significant capability for Bulldog against tanks, trucks, caches, pillboxes, bunkers, caves, wooden bridges, KOMAR's, and WBLC's. In other words, it is effective against targets for which Rockeye is effective as well as targets for which bombs are effective. Should AV-8A bombing accuracy prove to be near that of the CP-471 system, serious consideration should be given to incorporating a Bulldog capability into the aircraft (see paragraph 703d).

c. Maverick. The effectiveness of EO/TV homing weapons of the Walleye type has been demonstrated in Southeast Asia. The Tactical Air Armament Plan of TAAS and subsequent guidance shows that the Navy plans to convert its available EO/TV homing weapon resources to the heavy (2,300-pound) Walleye II configuration. Because of the limited load-carrying capacity of the AV-8A, it is unlikely that Walleye II will ever be used with this aircraft. The Air Force developed Maverick, a smaller and lighter (500-pound) system, appears to offer the accuracy of a homing EO/TV weapon compatible with the load carrying capability of the AV-8A. This weapon might offer significant capability against bridges, buildings, tanks, trucks, ships, pillboxes, bunkers, and caves. It is suggested that the possibility of incorporating the Maverick system into the AV-8A be explored further.

d. Shrike. The usefulness of Shrike would be against such targets as radar directed AAA sites, countermortar radars, and possibly SAM sites. Potential increase in enemy radar-controlled weapons indicates that a capability of firing Shrike from the AV-8A might be desirable. More study would be required to determine the aircraft alterations necessary to incorporate the Shrike capability. The cost and desirability of these alterations should be weighed against the potential radar-controlled weapon threat for AV-8A missions.

e. Harpoon. Little is known about the specific details of Harpoon at this time. It is currently envisioned as a 1,200-pound missile. The symmetric loading of the AV-8A would require two missiles to be carried. The AV-8A would most likely operate with Harpoon from a Sea Base. It is currently

[redacted]

[redacted]

felt that Harpoon targets (enemy ships) would be initially detected by radar and the initial fire control solutions generated by the aircraft radar. The AV-8A does not have a radar, hence its fire control information would probably be based on the pilot's visual acquisition of the enemy target or possibly on a radar vector from another friendly vehicle. If visual acquisition were required, there would be little need for Harpoon's long standoff capability. If the AV-8A approaches to visual acquisition range, it would probably be better off to make a run on the target with Rockeye, rockets, or guns and attempt to obtain a firepower kill on the ship. Alternative weapons might be Maverick or Bulldog (if the ship can be illuminated). It is felt that incorporation of Harpoon capability in AV-8A is a subject for further study. Particularly, the radar vector tactic should be studied.

706. (C) AV-8A Ordnance Requirement Analysis.

a. It was felt that an attempt should be made in this report to estimate combat ordnance requirements for a deployed AV-8A squadron. It is not feasible to try to determine accurate percentages of weapon types that would be universally applicable to every type of deployment in any area of the world, as there are too many variables. A rough estimate of ordnance percentages in the mix of weapons can be made on the basis of the P_k data, the assumed frequencies of missions, and in cases where data is not available, on subjective judgment. Obviously, the percentages of ordnance types cannot be made on a P_k basis only, because these data are not complete for all weapons, notably the Aden 30mm guns and the Zuni rocket with the Mk 63 VCMR warhead. Also, some weapons which do not show up well on a P_k basis have other reasons for being included in the ordnance mix. The estimates given are based largely on extrapolated P_k data, on assumed frequencies of mission occurrence, and on subjective judgment. No consideration is given to cost in the analysis.

b. In any actual deployment, operational judgment, the area of deployment, the nature of the enemy, the reason for deployment, and the actual availability of weapons in the Navy stockpile will affect the mix of ordnance.

c. In the analysis in this annex, essentially only three weapons were chosen as "best" for most targets--Rockeye II, Mk 81, and Mk 82 bombs (including Snakeye and conical fins). There were a few selections of rockets and Mk 83 bombs. Other weapons should be included in the mix for different reasons. The Aden 30mm gun should be included for its usefulness for attacking targets of opportunity, and its forward firing capability, useful, for example, in providing

[redacted]

[redacted]

suppressive fire to protect downed aviators in search and rescue operations. Some mix of Zuni rockets (particularly with the Mk 63 warhead) and 2.75-inch FFAR pods should be included, again for their forward firing capability and usefulness against targets of opportunity; also, in a few cases, rockets were the best on a P_K basis. Firebombs (Mk 77) should be included for their psychological effects and their ability to be utilized closer to friendly troops than high explosive weapons.

d. It is felt, subjectively, that these weapons (guns, rockets, firebombs, and possibly the CBU-55/B fuel air explosive) should constitute at least 25 percent of the air-to-ground ordnance mix for the AV-8A. The remaining 75 percent of the mix should consist of Rockeye II and iron bombs, except as discussed in subparagraph f. below. Since the analysis in this study showed no marked preference between Mk 81 and Mk 82, no distinction will be made between them here, and they will be referred to simply as "bombs."

e. The assumptions made on the relative frequencies of the three missions were: 85 percent of the AV-8A sorties for close air support, 10 percent for deep air support, and 5 percent for armed reconnaissance. The relative frequencies of "best weapon" choice between Rockeye and bombs (exclusive of rockets or other weapons) for the targets in these missions were approximately:

CAS: Rockeye for 90 percent of the targets.
Bombs for 10 percent of the targets.

DAS: Rockeye for 30 percent of the targets.
Bombs for 70 percent of the targets.

AAREC: Rockeye for 50 percent of the targets.
Bombs for 50 percent of the targets.

Combining these figures linearly and applying the mission weighting percentages results in:

.85 (.90 RE + .10 B) = .765 RE + .085 B for CAS
.10 (.30 RE + .70 B) = .030 RE + .070 B for DAS
.05 (.50 RE + .50 B) = .025 RE + .025 B for ARREC

where RE stands for Rockeye and B stands for bombs. Adding and combining the similar terms results in:

.82 RE + .18 B

[redacted]

[redacted]

Since these figures apply to only 75 percent of the total air-to-ground ordnance mix (25 percent being reserved for guns, rockets, etc.), these factors should be reduced by 75 percent. This results in a total ordnance mix of:

62 percent Rockeye
13 percent bombs
25 percent gun ammo, rockets, firebombs, FAE

f. It should be recognized that the mix above, established largely on the basis of kill probabilities, results in a relatively high proportion of Rockeye for close-air support (CAS) missions and a relatively low proportion of firebombs. However, the effectiveness of CAS weapons often depends on psychological and other suppressive effects as well as kill probabilities. Depending on the degree to which Rockeye is found to be effective as a CAS weapon, it may be desired to substitute firebombs for some of the Rockeyes in the ordnance mix postulated above. The exact composition of the desired mix will, therefore, depend on the degree to which Rockeye is found to be effective in support of infantry as well as on the tactical situation.

[redacted]

SECTION 8. SUPPORT EQUIPMENT REQUIRED TO MAINTAIN THE ARMAMENT EQUIPMENT OF THE AV-8A (U)

801. (U) General. Two topics will be considered in this section relative to the maintenance of the AV-8A's armament equipment: bomb racks and launchers.

802. (C) Weapon Racks for the AV-8A

a. The AV-8A has five store stations, the centerline station, two inboard wing stations having a 7.0 g-rated capacity of 1,100 pounds, and two outboard wing stations with a 7.0 g-rated capacity of 600 pounds. Many of the weapons the AV-8A is to deliver are in the 500-pound class, so the capacities of the wing stations typically allow two stores to be carried on the inboard station and a single store on the outboard station. The centerline station is somewhat space limited, being flanked on either side by the gun pods and fore and aft by the landing gear. For this and other reasons, the centerline station appears best suited to carry a single store.

b. The British-built rack supplied with the AV-8A is the Ejector Release Unit No. 119 Mk 1 (ERU-119). One of these racks is carried by each wing pyon and on the centerline station. For use on the inboard wing stations primarily, the British are using a twin store carrier that has two of these ejector units side by side that release the stores vertically. Some of the features of the ERU-119 are 14-inch suspension spacing only, the use of two ejection cartridges, ejection attitude control by means of replaceable gas throttles (orifices), and wrench-tightened sway braces. This basic rack seems to be relatively simple and appears to be designed for easy maintenance.

c. The inboard wing stations (possibly the outboard wing stations) could be fitted with auxiliary racks to provide the capability of carrying two or three weapons. The Triple Ejection Rack (TER) presently in the inventory can be accommodated on the wing stations, but all three stations on the TER cannot be loaded because of interference between weapons on adjacent wing stations on ejection. The TER might be used in an interim period, but these stations will almost certainly be fitted eventually with racks for two or more weapons that eject vertically, much as the twin store vertical ejection rack used on British aircraft.

d. Among presently operational aircraft, probably the most comparable to the AV-8A in the weapons to be delivered, in store station weight capacity, and in weapon system

[redacted]

complexity is the A-4. In an attempt to gain insight into AV-8A operations, a set of conventional weapons checklists for the A-4 aircraft were reviewed to determine the amount of special test equipment and tools that are required to check out and arm the A-4 with a variety of free-fall weapons and with rockets and guns. The results of this effort are summarized in Table G-8-1.

e. Considering the test equipment listed in Tables G-8-1 and G-8-2 (see paragraph 803), it is pertinent to note that there is essentially no commonality between test sets for racks, launchers, and weapons, even though the same armament circuits of the basic racks and of the aircraft are used for many weapons. The great diversity of test sets alone argues against both the large number of different weapons the AV-8A could deliver and the planning of dispersed operation of the aircraft due to the amount of support equipment it takes to insure adequate maintenance of the armament system and the proper loading of weapons.

f. Consumable items for the weapon racks when reloaded are few in number. In a TER, for instance, there are only two kinds of ejection cartridges used, and there is a filter plug (P/N 2171790) that is occasionally needed. Arming wires and Fahnestock clips are expended with the weapon upon release. In general, the parts supply for racks does not present the problem that rack maintenance does. The combustion products caused by the burning of the ejection cartridges requires routine maintenance after each ordnance drop.

803. (U) Launchers for Guided Weapons. The four guided weapons that are weight-compatible with the AV-8A and the launchers and test equipment that are currently used for these weapons are listed in Table G-8-2.

a. Fitting the LAU-7A launcher for the Sidewinder missile to the aircraft requires an adapter for 14-inch suspension. This arises from the fact that the launcher offers only 30-inch suspension spacing, while the spacing on all AV-8A store stations is 14 inches. The British have fitted twin launchers to the outboard wing stations of the AV-8A so the problem may be reduced to choosing their adaptive hardware or making an adapter to fit present launchers to the 14-inch suspension.

[redacted]





TABLE G-8-1. (U) TEST EQUIPMENT AND SPECIAL TOOLS NEEDED TO LOAD A-4/TA-4 AIRCRAFT ACCORDING TO CONVENTIONAL WEAPONS CHECKLISTS*

Procedure or Weapon	Test Equipment or Special Tools
Release and Control Basic	AN/PSM-4 Multimeter or Equivalent Rocket Launcher Firing Circuit Test Set AWM-4 Test Set (Electrical Fuzing)** JATO Circuit Tester (49327-1/50L98)** AN/ASM-150 Test Set (CP-741/A) ALM-70 (ALE-29A) 1/2 OHM 5 Watt Resister (FSN 9N5905-923-2637)
GP Bombs	None
Firebombs	Fuel Gelling Unit Mk 1 Mod 0
Air-Laid Mines	None
Pyrotechnics	JATO Circuit Tester 49327-1 or 50L98** PMDR Operating Lever 500155-1** Flare Unlatch & Brace Removal Tool 67A312C1
Rockets/Launchers	Primary: Test Set, Firing Circuit, Rocket Launcher, TS-2876/AWM (53A53D1) with SEC 813, Revision B). Secondary: Test Set, Firing Circuit, Rocket Launcher, P/N 53A53D1 with SEC 813, Revision A. Secondary: Test Set, Firing Circuit, Rocket Launcher, P/N 53A53D1 with AAC 211. Primary: Shielded Stray Voltage Adpater Cable (Instructions for local manufacture of shielded cable at an intermediate maintenance level are contained in NAVAIR 17-15F-3). Alternate: (Only if Primary not available) Rocket Adapter Cable P/N 4067350 Hook Unlock Tool DAC3813724 Detent Lift Tool
Dispensers	Same as for Rockets/Launchers
CBU-55/B (FAE)	None

* Checklist series for the A-4/TA-4 aircraft is NAVAIR 01-85AD-75-1A2.
** Not applicable to AV-8A.

TABLE G-8-2. (U) GUIDED WEAPON LAUNCHERS AND ASSOCIATED TEST EQUIPMENT

Weapon	Launcher	Test Equipment[1,2]
Sidewinder, AIM-9B/D/G/H	LAU-7/A1	Test Set, Guided Missile Launcher, AN/ASM-20B Tester, Guided Missile, IR Source, TTU-304/E
Shrike, AIM-45	AERO 5A-1	Aircraft Electrical Circuit Test Set AN/ASM-149A Armament Firing Circuit Test Set TA-2875A (ISEC 1745 Incorporated)
Bulldog	AERO 5A-1	Bulldog Test Set Under Development[3]
Maverick, AGM-65A	No Navy Launcher	Target Simulator AN/DSM-77 Missile Test Set[4] Launcher Adapter Test Set[4]

1 Checking launcher and aircraft circuitry is done with an AN/PSM-4 Multimeter or equivalent.

2 It is assumed that aircraft power or power from an auxiliary source is available for the test sets.

3 When Bulldog propulstion circuits are to be tested, Launcher System Test Set AN/USM-248 (PMR/TS-79) can be used. Shrike guidance circuitry are used for Bulldog guidance section, so test sets shown for Shrike are usable.

4 A composite test set for both missile and launcher is also part of the WS-319A weapon system.

UNCLASSIFIED

[redacted]

b. TAAS indicates the LAU-7A (Sidewinder) and Aero 5A (Shrike) launchers are to be replaced by 1974 with a single launcher from which all of the rail-launched missiles may be delivered. The LAU-83A launcher is under development for these weapons, and alternative plans call for the development of a launcher with even more universal applicability. For the AV-8A, it may be desirable to have a launcher capable of carrying two Sidewinders on each of the outboard stations.

[redacted]





SECTION 9. AV-8A AIR-TO-AIR CAPABILITY (U)

901. (C) General. There are no comprehensive ways to measure air-to-air capability. Instead, a limited comparison to aircraft performance parameters is usually employed. A comparison of the AV-8A with other aircraft in the air-to-air role is hampered by a lack of complete flight test data. When these data are available, more complete and definitive comparisons will be possible. This comparison will deal with available information and is limited by that fact. The comparison is complicated by the fact that most VTOL aircraft have unique and, for comparative purposes with other type aircraft, strange capabilities.

a. Air-to-air capability has two aspects. One deals with capabilities as an interceptor, the other as an escort or self-defending "dogfighter."

b. The AV-8A may offer better capability as a day interceptor than most U.S. aircraft. It has established, at least unofficially, a time-to-climb-to-10,000-feet record. Its augmented turbofan engine allows more high-speed/low-altitude endurance than most U.S. fighter aircraft. The AV-8A has limited night and all-weather interceptor capability.

c. To evaluate its escort/self-defense role, the AV-8A must be considered on a more extensive basis. Table G-9-1 shows performance data for the AV-8A, the most extensively employed enemy aircraft, and the F-8H for comparison purposes. It is assumed the AV-8A is equipped with two 30mm gun pods and two AIM-9 Sidewinder missiles, with 50 percent internal fuel. The data are for the AV-8A with Pegasus 11 engine.

d. In air-to-air maneuvering combat, three things are generally recognized as important. These are (1) to gain and maintain an energy advantage over one's opponent, (2) to gain an angular position advantage without losing energy, and (3) to force overshoots if an opponent has an energy or heading advantage. Specific excess thrust is a good measure of an aircraft's ability to maintain and increase speed or altitude, hence energy level. Lacking this sort of information, thrust loading or thrust-to-sight ratio is a measure of this ability if aircraft have similar or comparable drag characteristics. A lower wing loading allows changes in angular position with less loss in energy. Wing loading and thurst-to-weight are thus good rough estimators of combat maneuverability. This combat maneuverability, along with maximum instantaneous turn and deceleration, are measures of an aircraft's ability to generate overshoots, the first if maneuvering air-to-air

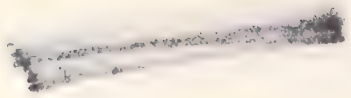


TABLE G-9-1. (C) AIRCRAFT CHARACTERISTICS COMPARISON

	AV-8A	MiG-17 Fresco C	MiG-21 Fishbed F	F-8H Crusader
Combat Weight (Pounds)	16,300	10,500	15,200	26,700
Wing Area (Square Feet)	201	243	248	375
Maximum Thrust (Sea Level Static, Pounds)	16,750	7,440	14,500	18,000
Wing Load (Pounds/Square Foot)	81	43	61	71
Thrust Loading T/W	1.02	.71	.95	.67
Maximum Speed at Sea Level (Knots TAS) Maximum Sea Level/Mach No.	590/0.89	570/0.86	660/1.0	660/1.0

combat is to be offensively successful, the second and third to be defensively successful.

e. As a conventional aircraft, the AV-8A, on first glance, has a higher thrust-to-weight ratio than the other aircraft. It also has a much higher comparative wing loading, with its attendant higher drag in high "g" turns. Both of these comparisons, however, must be modified by the unique characteristics of the AV-8A.

f. The thrust-to-weight ratio of the aircraft is a good comparison so long as the drag characteristics of the aircraft are similar. The AV-8A is a very high drag type of configuration as illustrated by its low maximum speed for such a high thrust-to-weight. This means that the AV-8A would probably have little excess-thrust-loading advantage versus the MiG 17 at any speed. The MiG 21, on the other hand, with a higher maximum speed, obviously has more excess thrust at high speed than the AV-8A. This would also be true at speeds much lower than the AV-8A's top speed, since the drag curve rises sharply as the top speed is approached. The MiG 21's net thrust advantage would probably hold down to speeds lower than 500 knots (for the tabulated sea level conditions, at higher altitudes the MiG 21's advantage would be even more extensive as the difference in maximum speed is higher and drag characteristics more advantageous at higher altitudes).

g. The AV-8A disadvantage in wing loading compounds its thrust problems. Conceptually, this disadvantage might be alleviated by using the aircraft's unique capability to vector thrust. This capability has been treated analytically several times in the past. A Center for Naval Analysis study (reference 10) treated AV-8A type thrust vectoring in maneuvering. The amount of wing loading that can be unloaded by thrust vectoring is as follows. At rest, the engine can be used to unload the wing by 1.0 g, since the airplane has VTOL capability. At V_{max}, the wing cannot be unloaded at all without slowing down. In between these extremes, the amount of unloading at constant turn velocity varies as the difference between the drag versus speed and net thrust versus speed curves do, at a slightly higher rate than $(V_{max}-V)^2$. Thus, at speeds near maximum speed, very little contribution from thrust vectoring is possible for constant speed and altitude turns. J. S. Antinello published a more recent study in the Journal of Defense Research (Summer 1970) on the thrust vectoring turn capability of the AV-8A configuration. The striking aspect of this analysis is the small minimum turn radius exhibited by an aircraft with the AV-8A's configuration. When the thrust is vectored, rapid deceleration occurs and a "wind-up-turn" of rapidly decreasing speed, and

thus of turn radius, can occur. An editor's note states that flight tests of the Pl127 Kestrel revealed its capability to change from a defensive to an offensive position against a Northrop T-38 chase plane. The article demonstrates that this position advantage is achieved at the expense of a velocity disadvantage due to the speed loss accompanying thrust vectoring.[1] In order to realize an offensive advantage, the AV-8A must then increase speed or energy level. This may not be easily done with the AV-8A's low excess thrust at higher speeds. This phenomenal wind-up turn of the AV-8A is thus a very good defensive air-to-air capability but may be a very poor offensive air-to-air capability.

h. Table G-9-1 illustrates an advantage for the AV-8A in air-to-air combat that is not often used in comparing aircraft. This is the entry for fuel consumption which shows that the AV-8A burns up fuel in combat at half the rate of the MiG 17/21. These fuel consumption figures are given in terms of the fraction of full internal fuel used per minute at maximum continuous thrust and are thus directly comparable. In general, the AV-8A should be able to employ defensive maneuvering until the MiG 17/21 reaches a low fuel state and tries to leave an engagement to return to base. Since its fuel consumption rate is so much lower, the AV-8A may be able to pursue the interceptors and fire missiles at them.

i. The AV-8A seems to offer a unique kind of maneuvering air-to-air capability. Its wing loading is much higher than the MiG 17 or 21. Its thrust loading would probably not compensate for this fact except at very low speeds (less than 300 knots). If the AV-8A attempts to use thrust vectoring, it results in a good defensive maneuver of position as large overshoots can be generated. This defensive position might be used to an offensive advantage by employing the AIM-9 Sidewinder from it. This requires close examination, as the envelope for this missile may be vanishingly small if the speed differential after the overshoot is very large and firing opportunities may thus be severely limited. The AV-8A has a low fuel consumption and this offers a greater ability to "stay and fight."

902. (C) Summary of Air-to-Air Capability of the AV-8A. As an interceptor, the AV-8A will have good capability for air

---

[1] This analytic demonstration involved an analysis of two aircraft with the following configuration: Pl154 aerodynamic characteristics, current AV-8A wing area and combat weight, Pegasus 101 engine. One such aircraft employing thrust vectoring was compared to one not employing thrust vectoring.

[redacted]

defense of a FEBA. As an escort/self-defense fighter, it has good full power endurance and a unique defensive turn capability. Its success in combat maneuvering will depend on its defensive turn and subsequent employment of its air-to-air missile.

[redacted]

[redacted]

SECTION 10. CONCLUSIONS (U)

1001. (C) AV-8A Weapon Complement

a. On the basis of the analysis in this annex (Section 7), the basic weapon complement for shipboard or shore-based operations for the AV-8A should include:

Rockeye II
Mk 81 or Mk 82 bombs (including Snakeye)
Aden 30mm guns
Sidewinder

For shore-based operations, the following additional weapons could be included but not at the expense of the above weapons:

Zuni with Mk 63 VCMR warhead
LAU-69A/A 2.75-inch FFAR pods
Mk 77 firebomb and CBU-55/B FAE

These last four weapons cannot be entirely supported on the basis of P_k effectiveness. P_k's are not available for Zuni/VCMR or CBU-55/B. The basis of argument for LAU-69, Mk 77, and CBU-55/B FAE is due to their ability to be used closer to friendly troops than the high explosive bombs or cluster weapons.

b. Based on the analysis in paragraph 706 in this annex, the approximate percentages of ordnance types to supply to a deployed AV-8A squadron are:

62% Rockeye II
13% bombs (Mk 81 and/or Mk 82)
25% mix of 30mm gun ammo, rocket pods, firebombs, and CBU-55/B FAE

These percentages are to be interpreted only as broad guidelines. They are without regard to cost and based on the many assumptions listed in paragraph 706. In any actual deployment, the percentages should be modified by operational judgment, the area of deployment, and the nature of the enemy, as well as the actual supply and availability of weapons in the Navy's arsenal. To some extent, it may be desirable to substitute firebombs for Rockeye in the close air support role.

c. Within the 1973-1980 time frame, the following weapons can be expected to be included in the AV-8A's basic complement:

[redacted]

[redacted]

(1) 500-pound version of Advanced BP Bomb (replacing Mk 81 and Mk 82).

(2) APAM (possibly replacing Rockeye II).

(3) High-speed FAE (replacing low-speed FAE).

Additional study is needed to assess the utility of the Advanced Incendiary Weapon and the Mk 82 version of the laser-guided bomb for AV-8A operations.

d. The only guided missile for which the AV-8A is currently configured is Sidewinder. It is the conclusion of this analysis that serious consideration be given to studying the possible inclusion of the capability to launch the Bulldog semi-active laser-homing guided missile and the Maverick electro-optical television homing missile and the Shrike anti-radar missile. Additionally, the utility of including the capability to launch the Harpoon anti-shipping missile should be explored.

e. One weapon for which data were sadly lacking in this study is the Aden 30mm gun. There are a few important cases where there appears to be a trade-off in effectiveness between the guns and Rockeye, notably on fast-reaction, and the fact that there are potentially competitive gun systems that will undoubtedly be proposed for the AV-8A, it is felt that additional study would be desirable to determine the effectiveness of the Aden 30mm gun.

[redacted]

(C) REFERENCES

1. Naval Air Systems Command, Joint Munitions Effectivess Manual, Air-to-Surface, Target Vulnerability (U), NAVAIR 00-130-ASR-1, 15 Aug 69 (Secret).

2. Chief of Naval Operations, Tactical Air Armament Study, Phase 1A (U), 24 Nov 1969 (Secret).

3. Chief of Naval Operations, Tactical Air Armament Study, Phase 1B (U), 17 Jul 70 (Secret).

4. Naval Weapons Center, APAM and Rockeye II: Comparative Effectiveness of (U) (Working Papers), Reg. No. 4072-22-70, 17 Aug 70 (Secret).

5. Ballistic Research Laboratories, Conditional Kill Probabilities for Single Fragment Impacts on Components of the Soviet ZIL-157 Truck (U), BRL MR 1949, Nov 1968 (Confidential).

6. Pacific Air Force, Weaponeering Analysis of PACAF Capabilities for Attacks Against Caves (U), by Captain R.A. Puckett (Working paper), PACAF (DITPRW), PACAF HQ, Hawaii 1969 (Secret).

7. Naval Weapons Laboratory, Vulnerability of Komar Patrol Boat to Underwater Blast (U), NWL Tech Report TR-21737, 10 Jul 68 (Secret-NOFORN).

8. NAVAIR 101B-601-15A, HARRIER Mk 50 (AV-8A) Aircrew Manual (Advance Issue), with Amendment Lists 1-21 incorporated (For Offical Use Only).

9. Commander Operational Development Force, Conduct An Operational Evaluation of the ZAP (Zero Anti-Aircraft Potential) Rocket (U), First Partial Report on Project 0/V86, COMOPTEVFOR ltr Ser 0049, 24 Apr 70 (Secret).

11. Center for Naval Analysis, Jet VTOL Aircraft: Implications for Attack Carrier Forces (U), INS Study 8, Jun 64 (Secret).

WARNING

This material contains information affecting the National Defense of the United States within the meaning of espionage laws, title 18, U. S. C. secs. 793 and 794. Its transmission or the revelation of its contents in manner to an unauthorized person is prohibited by law.

CLASSIFIED BY: DNA (DFX)
SUBJ TO GENERAL DECLASSIFICATION
SCHEDULE OF EXECUTIVE ORDER 11652
AUTOMATICALLY DOWNGRADED AT TWO YEAR INTERVALS
DECLASSIFIED ON: 31 DEC 97 1977

[redacted]

WARNING

This material contains information affecting the national defense of the United States within the meaning of the espionage laws, Title 18, U.S.C. Sections 793 and 794. Its transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law.

CLASSIFIED BY cmc(dtx)

SUBJECT TO GENERAL DECLASSIFICATION SCHEDULE OF EXECUTIVE ORDER 11652 AUTOMATICALLY DOWNGRADED AT TWO YEAR INTERVALS

DECLASSIFIED ON: 1979

[redacted]

(U) ANNEX H - DISTRIBUTION

CMC (AX) (40)
CMC (AA) (3)
CMC (A03)
CMC (A04)
CG, FMFLANT (2)
CG, FMFPAC
CG, I MAF
CG, III MAF
CG, 1st MARDIV
CG, 2d MARDIV (2)
CG, 3d MARDIV
CG, 4TH MARDIV
CG, 1st MAW
CG, 2d MAW (3)
CG, 3d MAW
CG, 4th MAW
DIRECTOR, EDUCATION CENTER
CG, 3d MAB
CG, FORTRPS, FMFLANT
CG, FORTRPS, FMFPAC
CG, 1st MAR BRIGADE
CO, LFTCLANT
CO, LFTCPAC
CO, TBS, MCDEC
CO, MCAS, QUANTICO
OIC, MCTSSA, MCB, CAMP PENDLETON, CALIF. 92055
CO, MAG-14
CO, MAG-32
CO, VMA-231
CO, VMA-513
CO, VMA-542
MCLnO, COMPHIBLANT
MCLnO, USACDC, FT. BELVOIR, VA. 22060 (2)
MCLnO, USAAVN TEST BD, FT. RUCKER, ALA. 36360
CHIEF, MARINE CORPS SECTION, USACGSC, FT. LEAVENWORTH, KAN.66027
MCLnO, NWL, DAHLGREN, VA. 22448
CNO (OP-03)
CNO (OP-05)
CNO (OP-34) (2)
CNO (OP-36)
CNO (OP-508)
CNO (OP-512)
CNO (OP-722)
CNO (OP-50C5)
CNA
CHNAVMAT
NAVAIRSYSCOM (5)
NAVORDSYSCOM

(U) DISTRIBUTION (CONTINUED)

NAVSHIPSYSCOM
NAVFAC (CODE 03)
CINCLANTFLT
CINCPACFLT
COMNAVAIRLANT
COMNAVAIRPAC
COMPHIBLANT
COMPHIBPAC
COMOPTEVFOR, NORFOLK, VA. 32511 (30)
COMPHIBSUPCOMLANT (CHMN AMPH WARFARE BD)
NAVAIRTESTCEN, PAX RIV
CDR, NAVAL WEAPON CENTER, CHINA LAKE, CALIF. 93555
CDR, NAVAL [illegible]P R&D CENTER, CARDEROCK, WASHINGTON, D.C. 20007
CDR, NAVAL [illegible]IP ENGINEERING CENTER, HYATTSVILLE, MD. 20782
CDR, NAVAL AIR ENGINEERING CENTER, PHILADELPHIA, PA. 191[illegible]2
DDC (2)
HISTORICAL AMPHIBIOUS FILE, MCDEC, QUANTICO, VA. 22134

UNCLASSIFIED

Security Classification

DOCUMENT CONTROL DATA - R & D

Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified

1. ORIGINATING ACTIVITY (Corporate author)

Marine Corps Development and Education Command
Quantico, Virginia 22134

[redacted]

3. REPORT TITLE

AV-8A Concept of Operations Study (U)

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Final Report of Tasks 1, 2, and 3

5. AUTHOR(S) (First name, middle initial, last name)

Larry K. GRISSETT, Maj, USMC Project Officer

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
August 1973	387	10

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
b. PROJECT NO 54-69-01	
c.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
d.	

10. DISTRIBUTION STATEMENT

In addition to security requirements which apply to this document and must be met, each transmittal outside the agencies of the US Government must have prior approval of the Commandant of the Marine Corps (Code AX).

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	Commandant of the Marine Corps (Code AX) Washington, D.C. 20380

13. ABSTRACT

This report presents a concept for sea based employment, land based employment, and phasing ashore of the AV-8A in amphibious operations. The report describes command and control procedures and logistic support requirements for each phase. (U)

CVA and CVS aircraft carriers and LPH and LHA amphibious ships are capable of serving as Sea Bases providing full support for AV-8A operations. Ships with helicopter landing platforms may serve as Sea Platforms for dispersal of AV-8A's. (U)

AV-8A operations in support of the landing force will occur in three distinct phases. Phase One features operations from Sea Bases -- Phase Two features implacement of a Facility, -- and Phase Three includes establishment of a Main Base.

During Phase One, fully armed and fueled AV-8A's will operate from Sea Bases. When required by the Commander, Landing Force, AV-8A's can land ashore at Forward Sites and stand by for on-call missions from nearby ground units.

In Phase Two, the AV-8A will be dependent upon Sea Bases for most logistical support, but will be capable of sustained, highly responsive close air support within the beachhead area.

As the amphibious operation progresses and if dictated by the situation, the AV-8A will enter Phase Three deployment which requires the establishment of

(Continued on the back)

DD FORM 1 NOV 68 1473 (PAGE 1) (It is page is unclassified)

S/N 0101-807-6801

UNCLASSIFIED



UNCLASSIFIED
Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
V/STOL						
Marine Aviation						
Expeditionary Airfields						
Sea Base						
Sea Platform						
Main Base						
Facility						
Forward Site						
Amphibious Warfare						
AV-8A Employment						

13. ABSTRACT (Continued)

of the Main Base which will provide for complete support of AV-8A operations ashore. Facilities and Forward Sites will continue to be established as desired to support the scheme of maneuver. (U)

This concept of operation is compatible with the Marine Air Command and Control System. When minimum response time is paramount, the Direct Air Support Center may assign forward based AV-8A's to be launched in direct response to mission requests from designated ground units. (U)

This concept of operation allows the AV-8A to provide responsive air support for the ground forces in all phases of an amphibious operation, to stage ashore early without extensive base development, and to improve the responsiveness of close air support. (U)





UG 1242 .V47 G85 1973a
Grissett, Larry K.
AV-8A concept of operations
study

DATE DUE

NOV 2 3 2006

FEB 0 7 2011

MARINE CORPS UNIVERSITY LIBRARY
2040 Broadway Street
Quantico, VA 22134-5107